270091

JPRS-UFM-88-008
5 AUGUST 1988

FOREIGN
BROADCAST
INFORMATION
SERVICE

JPRS Report

Soviet Union

FOREIGN MILITARY REVIEW

No 2, February 1988

10
62
A04

Soviet Union
FOREIGN MILITARY REVIEW
No 2, February 1988

JPRS-UFM-88-008 *5 AUGUST 1988*

CONTENTS

FOREIGN MILITARY REVIEW

According to Laws of High Vigilance

18010332a Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 3-6

[Lead article]

[Text] The Communist Party and Soviet government steadfastly and consistently follow a policy of peace in attempting to curb the forces of war and aggression and secure the peoples' right to freedom, independence and social progress. Having thoroughly weighed and soberly assessed the existing international situation, the CPSU proceeds from the assumption that there is no fatal inevitability of war no matter how great a threat to peace is being created by the politics of imperialism's aggressive circles. There must be a campaign for peace, however, and a determined, purposeful one. "Therefore," noted the CPSU Central Committee Political Report to the 27th congress, "the main direction of party activity in the world arena remains **the campaign against the nuclear threat and arms race and for preserving and strengthening universal peace.**"

The specific program for creating an all-encompassing international security system developed by the 27th CPSU Congress and supported by many countries was a specific confirmation of the Soviet people's peaceable aspirations. The dynamism and constructiveness of the Soviet state's foreign policy course and its practical direction toward detente, disarmament, and mankind's deliverance from general catastrophe became the basis for achieving a historic agreement between the USSR and United States in the field of disarmament signifying total elimination of two classes of nuclear weapons—medium and shorter range missiles. It was the Soviet Union's consistent policy that played the deciding role in achieving these fundamental and significant agreements. Thus while not very long ago few believed in the possibility of nuclear disarmament, today a major step already has been taken toward a non-nuclear world.

The reassuring events of international life unquestionably open up good prospects for realizing numerous initiatives advanced by the USSR. The CPSU and Soviet government understand, however, that our neighbor in world politics is an opposite system with respect to classes and that we are being resisted by a serious reality from the standpoint of preserving peace in the form of aggressive circles of world imperialism. Numerous facts indicate that influential reactionary forces in the United States as well as in Great Britain, the FRG, Japan and other imperialist countries are attempting to return interstate relations to "cold war" times and disturb the existing military-strategic parity of forces in their favor; that they are not giving up hopes of social revenge; and that they are accelerating the arms race. All this creates a military threat and dangerous tension in the world and may lead to a nuclear conflict representing a danger to mankind's destiny.

Under existing conditions the principal requirement placed on USSR Armed Forces personnel is to maintain high vigilance and constant readiness to defend the socialist homeland. Soviet soldiers must have a precise understanding of the political situation, constantly study the enemy, be able to discern the enemy's crafty intrigues, successfully counter his subversive activity and all kinds of ideological diversions, resolutely refute slanderous fabrications and provocative rumors, and strictly keep military and state secrets.

The vigilance of Soviet citizens originated with the revolutionary vigilance of the Russian proletariat and its Bolshevik party. It was shaped in the period of struggle against the autocracy and bourgeoisie, during preparation and accomplishment of the Great October Socialist Revolution, and in the years of the Civil War and establishment of the young Soviet state. The high vigilance of Soviet Army and Navy personnel in the Great Patriotic War was one of the factors contributing to victory over the fascist German invaders.

Noting the important role of high revolutionary vigilance in the struggle against enemies of the victorious proletariat in all fields of endeavor of the party and socialist state, V. I. Lenin particularly emphasized the importance of vigilance in military affairs. He pointed out that in a struggle against a crafty enemy "military discipline and military vigilance taken to the highest limits are necessary" ("Polnoye sobraniye sochineniy" [Complete Collected Works], Vol 39, p 55). The Communist Party and Soviet people invariably have been guided by this very important Leninist precept throughout the history of development of our state and its Armed Forces.

Resolutions of the 27th party congress and subsequent CPSU Central Committee plenums are of great importance for strengthening the Soviet Union's defensive capability and raising the Army and Navy's vigilance and combat readiness. Measures carried out in accordance with party resolutions to accelerate the country's social-economic development, conduct a social policy, further democratize public life, increase the initiative and creativeness of all Soviet citizens, strengthen law and order and discipline, and improve ideological indoctrination serve not only to increase Soviet citizens' welfare, but also to strengthen the USSR's defense might and security.

Materials of the 27th CPSU Congress contain a detailed analysis of the dialectics of trends which have taken shape in the international arena. One of them is the increased danger of imperialist aggression. The 27th party congress resolution on the CPSU Central Committee Political Report clearly reflected Lenin's assessment

that modern militarism is imperialism's most monstrous offspring. The responsibility for wars and conflicts of our time and for unleashing and escalating the arms race rests exclusively with imperialism. Capitalism's entire socio-economic nature prompts imperialist states to engage in military adventurism and to resolve their own problems by military confrontation with socialism and the developing countries above all and with each other to a certain extent.

The present active manifestations of imperialism's aggressiveness also have deep-seated economic and socio-political sources. The economics of imperialism based on private ownership unties the hands of ruling classes in the "military coercion" of workers within their own country and in the plundering of peoples of other states, and it is reflected in aggressive politics. "War is not an accident or a 'sin,'... but an unavoidable stage of capitalism," emphasized V. I. Lenin in persuasively demonstrating that the capitalist system acts as the source of military threat because of its fundamental traits and that imperialism transforms military force from a premise of violence into a functioning weapon of violence ("Polnoye sobraniye sochineniy," Vol 26, p 41). These Leninist theses became the basis of the conclusion formulated in the CPSU Program: "Imperialism is guilty of two world wars which took many tens of millions of lives. It is creating the threat of a third world war."

One reason dictating the need for our Armed Forces' high vigilance and combat readiness is the adherence of the most reactionary circles of imperialism to aggressive military-strategic concepts. Suffice it to say that present U.S. military doctrine provides for delivering a first strike and is oriented toward victory in a nuclear war.

An ominous trait of modern imperialism demanding high vigilance on the part of the Soviet Army and Navy is its more frequent use of military coercion in international relations. Millions of people died in local wars and conflicts provoked by the imperialists following World War II. The fact that today American imperialism impudently declares entire regions of the world to be a "sphere of vital interests" of the United States also says a great deal. It is no accident that the "service record" just of the present Washington administration includes such aggressive actions as the invasion of defenseless Grenada, the bombing of Lebanon and Libya, piracy in the Persian Gulf, and the undeclared wars being carried out with the help and support of the United States against Nicaragua, Afghanistan, Angola and Cambodia. The interventionist Rapid Deployment Force was created for direct U.S. military intervention outside NATO's "zone of responsibility," above all in the Near and Middle East. New American military bases are being modernized or established in various parts of the world.

Militarism has permeated the entire economic and socio-political structure and spiritual life of countries of imperialism like a cancerous tumor. It engendered a brainwashing of monstrous scope of the population and personnel of armed forces of NATO countries in a spirit of anticommunism, antisovietism, preaching of the cult of force, and praising of weapons of aggression.

The West's propaganda machine standing at the service of capital has been activated today as never before. It uses modern technical resources, refined ideological subversion and psychological techniques. The 27th CPSU Congress noted that in no other period of its existence has mankind experienced such pressure of falsehood and deception as now. Having unleashed "psychological warfare," imperialism directs it toward creating broad public opinion about the "inevitability" of a struggle against socialism and communism by military means, and toward deceiving peoples and concealing from them the imperialist reaction's true aspiration for world domination.

The entire course of society's modern development confirms that lying imperialist propaganda has become more refined as world socialism's successes have become more significant and its authority and influence on international affairs have become higher. It heaps skillfully prepared misinformation on Soviet citizens, attempts to impose alien thoughts and feelings on them, and tries to stifle patriotism and love for the Motherland, sow unconcern, and instil such base qualities as consumerism, money-grubbing and others.

Vigilance assumes special meaning as applied to the present world situation and to the need for armed protection of socialism. It has clear-cut political, military and moral-psychological aspects.

Vigilance in the political plane signifies taking a precise class position in assessing social phenomena and being irreconcilable toward the hostile bourgeois and revisionist ideology and any of its manifestations and toward all kinds of intrigues of forces acting against socialism and communism. The political vigilance of Soviet military personnel is based on their profound ideological conviction and utter dedication to the cause of communism. It presumes a high level of political awareness and systematic work to instil such awareness.

Vigilance in the military sense, connected inseparably with the political aspect of the matter, is inconceivable without high combat readiness for armed defense of socialism's achievements at all levels of our military organization from the Armed Forces as a whole to units, ships, subunits and every individual serviceman. Vigilance has special significance in performing alert duty, guard duty and watch. Alert duty in all branches of the Armed Forces and in guarding the USSR state border and especially important installations is the performance of a combat mission even in peacetime.

Vigilance in the moral-psychological plane signifies each serviceman's deep awareness of his military duty, strict compliance with requirements of the military oath, regulations and instructions, and the ability to preserve high

combat qualities—staunchness, courage, and will to win—both in ordinary and in critical situations demanding maximum exertion of all moral and physical forces.

The need for increased vigilance today advances to the fore the task of indoctrinating military cadres and all personnel in a spirit of supreme responsibility for successful accomplishment of defense missions. The violation of the USSR's air border by a light-engine sport aircraft of the FRG was a stern lesson. It is common knowledge that the carelessness, indecisiveness, irresponsibility and lack of discipline displayed by a number of Air Defense Forces officials were resolutely condemned. The incident involving a violation of the country's air space showed how vigilance becomes dulled where stagnant phenomena have not been eliminated and where there is no healthy moral atmosphere and party criticism and self-criticism. This instance obligates every person in the military to thoroughly understand the full importance of missions assigned by the June 1987 CPSU Central Committee Plenum to increase vigilance, act even more resolutely, and strengthen discipline, efficiency, responsibility and execution at all levels.

Life constantly confirms that vigilance is integrally linked with combat readiness. To be vigilant means to constantly improve one's military proficiency, know combat equipment and weapons excellently, handle them well, and be able to hit targets at maximum range with the first round or launch. The important thing here is to teach troops what is necessary in war.

Firm military discipline is a most important component of high vigilance. It demands faultless efficiency and execution, extreme precision and exact fulfillment of the oath, military regulations and orders.

Missions involving increased vigilance and combat readiness demand maximum composure and initiative of military cadres and all servicemen, renunciation of outdated methods of organizing duties, demonstration of mutual principle, and a display of creativeness in military labor.

The personnel's exemplary, vigilant performance of alert duty—keeping specially assigned forces and resources in a high degree of combat readiness to accomplish missions arising suddenly or to conduct combat actions—assumes more and more significance for the purpose of disrupting a surprise attack by the probable enemy. Even the slightest infractions of discipline and any instances of connivance and complacency are especially intolerable here.

Vigilance must be filled with sufficiently specific content in the tense international situation created through the fault of reactionary forces. It demands that every Soviet citizen have a certain social and class orientation and a direction of awareness and practical action conforming to communist ideals and to the interests of defending socialism. For every serviceman vigilance is manifested not only in an understanding of the reactionary essence of affairs and plans of imperialism's militant circles, in a precise realization of the threat stemming from the class enemy, and in an irreconcilable attitude toward him, but chiefly in maintaining that status of Army and Navy forces which permits giving the aggressor a crushing rebuff.

"Prevention of war and readiness to rebuff an aggressor," emphasizes USSR Minister of Defense Army Gen D. T. Yazov, "are two tasks that are interconnected and determined by the fact that the United States and NATO are not rejecting first use of nuclear weapons, they are building up their strategic offensive potential on an enormous scale, and they are attempting to achieve military superiority." To counterbalance that military-force policy of the North Atlantic Alliance, Warsaw Pact member states are acting from the constructive position of new political thinking. The fundamental novelty of the Warsaw Pact military doctrine adopted by the Political Consultative Committee in May 1987 is that it is not simply defensive, but is aimed at preventing war. Its provisions are a logical continuation of the socialist countries' firm, consistent struggle for strengthening peace and eliminating interstate confrontations. The logic of the new military-political thinking is manifested in the combination of the defensive nature of the socialist community's military doctrine and firm conviction about the need for ensuring survival of socialism's achievements.

It would seem that this character of the Warsaw Pact military doctrine should prompt each and every one to get right down to work on problems of normalizing the planet's political climate, curbing an arms race that is pernicious for the fate of the world, and thoroughly resolving acute international conflicts. Blinded by egotistic class interests, however, the West's reactionary and militaristic circles do not wish to give up their bigoted views on the development of world events. They continue to rely on confrontation with socialism and clutch at the obsolete policy of acting "from a position of strength."

The Soviet Union and other countries of the socialist community are countering this threat with a constructive program of measures aimed at stopping the arms race, at disarmament, and at creating an all-encompassing system of international security. An increase in vigilance of Armed Forces personnel and all Soviet people and a strengthening of defensive capability of the Soviet Union and other countries of the socialist community have the greatest significance under present-day conditions along with a consistent struggle for guarantees of a safe world.

6904

Aggressive Essence of New U.S., NATO Concepts

18010332b Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 7-17

[Article by Lt Gen I. Perov]

[Text] In recent years the military departments and research organizations of the United States and NATO have been conducting extensive studies to work out new and more aggressive concepts of warmaking against the Soviet Union and other Warsaw Pact countries and for creating (the United States above all) new destructive weapons of warfare including conventional weapons which may be comparable in capabilities with low-yield nuclear weapons.

In 1982 the Pentagon officially adopted the concept of the **"air-land operation (battle)."**[1] It contains a qualitatively new view taken by the U.S. military leadership of the nature and methods of conducting combat actions, with special significance attached to conducting joint air-land battles and operations by large strategic formations and large units of ground and air forces. The foreign press emphasizes that offensive air-land battle operations will bear a transient and decisive character and will combine broad troop maneuver and the mass employment of highly efficient weapons to a great depth. This concept rests on the following principles: seizing and holding the initiative at the earliest stage of armed conflict, disorganizing the enemy by delivering powerful strikes from unexpected directions, consolidating success swiftly, and depriving the opposing grouping of an opportunity to restore its combat effectiveness. To realize these principles powerful strikes will be delivered against the most important elements of the operational alignement of enemy troops and against installations, destruction of which will undermine the coordination of enemy actions and thus will permit the American (coalition) troops to accomplish assigned missions with fewest losses of forces and resources. American specialists emphasize that such actions must be unpredictable and disorienting for the enemy and the rate of advance must be high enough to deprive his troops of an opportunity to take effective countermeasures. The battle will extend from positions at which there will be close combat to areas where troops are only beginning to move up to the front.

The importance of rear entities also grew with an expansion in scale of combat actions. The foreign press emphasizes that continuous logistical support to large and small units in all stages of the air-land operation is the primary mission of rear forces and resources. In this connection the stable and uninterrupted functioning of sea lines of communication (between the European and North American continents above all) will play an especially important role for the United States and NATO in conducting lengthy combat actions in Europe. Therefore views on the operational-strategic employment of naval forces have seen further evolution in recent years. For example, there is a wide discussion in the pages of the military press about the so-called U.S. "sea strategy," within the framework of which a new concept of **"air-sea operation"** is being examined.

Principal reliance in contemporary U.S. naval strategy is placed on large strategic naval formations and forces [soyedineniye] conducting offensive operations with the objective of winning supremacy in the most important parts of ocean and sea theaters, inflicting maximum damage on the enemy fleet in the earliest stage of war and forcing him to concentrate basic efforts primarily on defensive operations in coastal zones.

Mass employment of cruise missiles against naval and coastal targets together with deck-based, tactical and strategic aviation is envisaged in accordance with the "air-sea operation" concept.

Adoption of a new naval strategy in the United States and planning of air-sea operations became possible in connection with implementation of plans for building combatant ships which incorporate recent achievements of science and modern technology, as well as wide-scale outfitting of naval forces with highly efficient guided weapon systems, including long-range systems.

The foreign press notes that by the mid-1990's there will be a substantial qualitative renewal of the U.S. Navy order of battle. By this time it is planned to have at least 200 nuclear-powered submarines and surface combatants carrying Tomahawk cruise missiles and to further equip naval forces and naval aviation with Harpoon antiship missiles.

In the opinion of foreign specialists, ships carrying cruise missiles have great attack capabilities as well as powerful means for their own defense against strikes by enemy aircraft, submarines and surface combatants. For example, the American "Ticonderoga"-Class cruiser "Bunker Hill" which was commissioned in 1986 after completion of construction is equipped with two vertical launchers (122 containers) from which it is possible to launch Tomahawk cruise missiles, Standard-2 surface-to-air missiles and ASROC antisubmarine guided rockets. Other ships under construction also are being fitted out with the very same launchers, but with a lesser number of containers. Some "Spruance"-Class destroyers have vertical launchers for the very same missiles as the "Bunker Hill."

As American strategists emphasize, if the "Spruance"-Class destroyer will have only half the containers with Tomahawk cruise missiles (30 missiles), then even in this case the destroyer's capabilities for delivering strikes against coastal targets can be comparable with a strike by a group of six deck-based A-6E Intruder attack aircraft against enemy targets situated at the maximum radius of action of these aircraft with maximum combat load.

During exercises and combat training the U.S. Navy intensively works out and studies principles of employing new formations—so-called missile striking forces (RUG) made up of ships carrying Tomahawk cruise missiles. Such forces usually consist of 4-6 ships including a nuclear-powered multirole submarine and are headed by a battleship carrying cruise missiles. These ships can have an overall total of 60-100 or more Tomahawk cruise missiles aboard (depending on the assigned combat mission), intended for delivering strikes against coastal targets. The foreign press emphasizes that the missile striking force's tactical capabilities in accomplishing this mission can be compared with the strikes of more than 30 deck-based A-6E Intruder attack aircraft, i.e., equivalent to one sortie of this type of attack aircraft from two or three carriers (from 12 to 24 such aircraft can be based on each).

The missile strike group has a sufficiently strong antiaircraft and antisubmarine defense as well as great capabilities for engaging surface combatants. It is capable of effectively repelling an attack by enemy airborn targets out to 150 km from the center of the group, of searching out and destroying submarines within a radius of up to 180 km, and delivering strikes against enemy surface combatants with Tomahawk antiship missiles at ranges over 500 km.

In the assessment of American specialists, the following are the basic advantages of combined units equipped with Tomahawk cruise missiles: concealed deployment to areas of upcoming tactical employment (applies to nuclear-powered submarines above all); possibility of delivering powerful surprise strikes against enemy installations (from nuclear-powered submarines above all, from which missile launch is accomplished from a submerged condition); great effective range and high accuracy on target (the range of cruise missiles against ground targets is 2,500 km in a nuclear loading and up to 1,500 km in a conventional loading, and against waterborne targets it is over 500 km; the accuracy (CEP) is to 5 m against waterborne targets and to 30 m against ground targets; they are relatively invulnerable because they fly at heights of 60-200 m and have low radar reflectivity); and elimination of flight personnel losses inasmuch as the cruise missiles are unmanned.

The missile striking force's operations in ocean and sea theaters can be either independent or carried out jointly with other naval forces as well as with tactical and strategic aviation.

It is believed that the following missions may be assigned missile striking forces and ships carrying cruise missiles in the course of an air-sea operation:

—Delivery of mass strikes against enemy naval forces at sea and in base with the objective of winning supremacy in ocean and sea theaters;

—Destruction of enemy air defense installations in the interests of combat operations of deck-based, tactical and strategic aviation (i.e., air defense system command posts, ZRK [surface-to-air missile systems], radars, airfields where fighter-interceptors are based and so on);

—Delivery of highly effective mass strikes against ground installations from different sea sectors, which will complicate the situation for the air defense forces and resources repelling these strikes;

—Delivery of so-called "surgical" strikes against the most important enemy military and industrial installations, particularly against command posts, airfields, ammunition and POL depots, ports, oil refineries and so on.

In the estimate of foreign specialists, in air-sea operations the basis for effective employment of the American Navy's mixed forces, including ships carrying cruise missiles, is thorough planning for such operations and precise coordination of force employment for accomplishing missions with consideration of the effectiveness of different weapon systems. They believe in particular that it would be wasteful to employ Tomahawk cruise missiles for delivering strikes against enemy destroyers, since this mission can be successfully accomplished by Harpoon antiship missile platforms (with a range up to 130 km). It is also inexpedient to use F/A-18 Hornet aircraft for strikes to neutralize enemy shore SAM systems, since losses of aircraft and flight crews will be unavoidable here. In their assessment this mission can be successfully performed by Tomahawk cruise missiles.

The U.S. military-political leadership considers ships carrying cruise missiles to be an effective tool for "pressuring" the enemy, particularly in areas where a crisis situation has developed. An example of the practical implementation of that approach is the 1987 deployment of the battleship "Missouri" equipped with Tomahawk cruise missiles as part of the American naval grouping in the Persian Gulf, permitting the Pentagon to create a real threat of their surprise use against Iran's most important military and political installations, including those located at a great depth.

In analyzing the experience of exercises conducted by branches of the U.S. Armed Forces in accordance with concepts of the "air-land operation (battle)" and "air-sea operation," American specialists conclude that there is a need for making certain adjustments to the operational art with the objective of maximum use of the advantages of existing conventional precision weapon systems and, most important, the advantages of such systems being created . In particular they believe it necessary to have closer coordination and a more precise distribution of missions among branches of the Armed Forces when they conduct combat actions simultaneously in contiguous continental and sea TVD [theaters of military operations]. The conclusion drawn from all this is that it is necessary to have a unified concept, the "air-land-sea

operation (battle)," which would provide for maximum effective employment of many precision weapon systems (varying in purpose and effective range) for inflicting heavy damage on forward groupings of armed forces of Warsaw Pact states from the very outset of a war.

The Pentagon intensively began to impose this idea on its NATO allies and a feverish search began for ways to achieve this objective. As a result, under Pentagon pressure the bloc military leadership adopted a new NATO-wide concept in 1984 under the name "Follow-on-Forces Attack (FOFA)," which was worked out at the initiative of former Supreme Allied Commander Europe Gen B. Rogers and became part of North Atlantic Alliance military strategy as an official concept. It was officially approved by the Military Planning Committee in the "Guidance for Further Planning of Armed Forces Employment Under the FOFA Concept."

Publication of this document does not signify a fundamental revision of the general NATO strategy of "flexible response." It continues to be based on balanced development of the triad of general-purpose forces, theater nuclear forces, and strategic nuclear forces. The NATO military-political leadership's reliance on first use of nuclear weapons remains unchanged.

NATO strategists emphasize that the FOFA concept is one of the key elements in building up the attack might of conventional forces by developing the latest kinds of military equipment and precision guided weapons based on adoption of the most up-to-date technology.

In accordance with the new concept, armies of bloc countries must have those attack capabilities allowing NATO to conduct wide-scale offensive combat actions employing only conventional weapons against groupings of Warsaw Pact armed forces from the very beginning of the war. Its basis consists of requirements for mass employment of precision conventional guided weapons of various types and ranges against troops and installations of Warsaw Pact states located not only in the immediate combat zone but also in the deep rear. NATO strategists proceed from the assumption that the greater the depth to which enemy troops and installations are engaged, the fewer personnel and pieces of equipment that will remain for the enemy to change the course of combat operations. Conversely, the capabilities of NATO armed forces for defeating the enemy forward grouping and conducting offensive combat actions to achieve the war's political and military-strategic objectives will grow under these conditions.

A special report prepared by the Technology Assessment Board of the American Congress appeared in the United States in 1987 entitled "New NATO Technology Means Implementation of the FOFA Concept." One of its basic lines is pressure on West European allies for a further increase (over three percent) in their real military expenditures to create an appropriate physical base for implementing provisions of the new bloc concept.

It follows from foreign press reports that the basic requirements of the FOFA concept, sometimes called the "Rogers Plan," are the containment, disorganization and destruction of second echelons (reserves) of Warsaw Pact troops before they can be committed to a battle or action.

In the definition of NATO strategists, *containment* can be achieved by creating chokepoints in the path of second echelons of enemy troops directly in the combat zone and, especially important, as they move from deep rear areas. Destroying bridges, especially on water obstacles, delivering strikes against route centers, creating zones of flooding in the militarily most important areas, and so on are considered very effective for these purposes. NATO specialists note that in case the enemy delays commitment of large units even for several hours, this can have a decisive influence on the outcome of an action. It is assumed that if rail movements of strategic reserves from the deep rear can be disrupted for several weeks, favorable conditions will be created for defeating the forward grouping of Warsaw Pact troops.

Disorganization consists of entirely disrupting or hindering fulfillment of enemy troop actions which are coordinated in time. Western specialists believe that this depends on the degree to which organizational integrity of large strategic formations and large and small units of the second echelon is disrupted. This can be achieved above all by disabling (destroying) command posts and personnel as well as disrupting (neutralizing) the system of personnel and equipment. *Destruction* signifies putting a large quantity of military equipment, personnel and troop logistics out of action, as a result of which an enemy grouping may lose combat effectiveness, will be incapable of performing the combat mission and will have to be removed from the combat zone.

All FOFA missions are placed in categories according to requirements drawn up in NATO, with targets (objectives) and degree of planned effect corresponding to each category (Table 1).

According to the definition of NATO specialists, the concept of "second echelon" includes both the second echelon of the initially deployed enemy troop grouping as well as all subsequent large and small units of similar strength when they advance to corresponding positions (or into areas). For example, the term "second echelon regiments of divisions conducting combat actions" (category I missions) includes regiments both of the second echelon of large units that are fighting as well as of all second echelon divisions and reserves in the stage of their forward movement to a depth of 5-30 km.

A detail of personnel and equipment is assigned, methods of combat actions are determined, and the degree of engagement of targets (objectives) depending on their distance is established for executing missions of each category (Table 2).

Mission Category	Planned Effect	Echelon (Strike Target)	Distance from Line of Contact Toward Enemy, km
I	Destruction	Second echelon regiments of divisions conducting combat actions	5-30
II	Destruction	Second echelon divisions from first echelon large strategic formations	30-80
III	Disorganization or containment	Second echelon (reserves)	80-50
IV	Disorganization or containment	Operational second echelon (large strategic formations in second echelon)	150-350
V	Containment	Strategic second echelon (major second echelon strategic formations)	350-800

As the western press reports, divisions moving up to the front can have approximately 55 march groups, each with around 60 vehicles (in the specialists' estimate, there are that many in battalion and equivalent subunits) and 15 groups of lesser composition (each up to a company). They are considered potential targets in delivering strikes against large second echelon units which are in concentration areas during the march.

NATO specialists note that when a division makes the march to the front its regiments move up to forming-up places for the offensive. In the final movement phase combat formations of regiments proceed at the head of columns and the bulk of auxiliary equipment and personnel of rear entities will move behind them.

The following organization of the sequence of strikes against enemy columns is provided with consideration of provisions of the FOFA concept and missions assigned to the troops and in accordance with the presumed movement plan of enemy columns from concentration areas.

Category I missions are strikes to a depth of 5-30 km against second echelon regiments of already committed divisions located approximately 5-30 km from the line of contact, i.e., in a zone up to the fire support coordination line. The latter usually coincides with the range of field artillery fire and is designated for coordinating the fire (strikes) of ground and air weapons. It is believed that up to a regiment should be destroyed as a result of strikes against these units, i.e., that quantity of combat equipment and personnel is disabled which deprives the enemy of the capability of performing assigned combat missions.

The most preferable time for attacking an enemy troop column is considered the time of their movement along roads in the final phase before deploying into combat formations. This is based on the assumption that regiments still will be proceeding in columns by battalion (40-60 vehicles in each), with combat subunits in front. It is believed that there can be up to eight targets (objectives) of strikes in each regiment, each up to a battalion in size. The proportion of combat vehicles in them will be approximately 70 percent of the total number in the regiment.

The time enemy battalions are in columns when moving along roads from the forming-up place to the line of deployment will be no more than 30-60 minutes. It requires 1.5-2.0 hours on the whole for a regiment to move to the combat zone. Based on this it is believed that an army corps of one of the NATO countries situated on the enemy's axis of main attack can expect the arrival of up to seven second echelon regiments of enemy troops in the combat zone within 24 hours. That calculation is based on the fact that a corps initially conducts combat actions against three first echelon divisions, and one more division will be committed in 24

Targets (Objectives)	Distance from Line of Contact, km				
	5-30	30-80	80-150	150-350	350-800
Moving columns	Dest	Dest	Diso		
Large and small units in concentration areas	Dest	Dest	Diso		
Command posts		Diso	Diso		
Chokepoints (bridges, stations and sections of railroads), halted large and small units			Diso	Diso	
Large and small units being moved by rail				Diso	
Large and small units in transshipment areas				Diso	
Large and small units being moved by rail					Cont
Rail network					Cont

KEY: Dest--Destruction; Diso--Disorganization; Cont--Containment

hours. It is believed that the movement of enemy battalions will be accomplished rather quickly; therefore it is necessary to assign that detail of personnel and equipment for engaging them which would be sufficient for knocking out at least a battalion in the first attack.

Category II missions are strikes to a depth of 30-80 km against second echelon divisions of large strategic formations taking an immediate part in an operation. According to specialists' calculations, at this time they can move up along roads from concentration areas to the forming-up place for the offensive, executing a march in groups (up to a regiment in size) proceeding in columns along two or more routes. Of the total number of division columns (more than 50, each up to a battalion in strength), approximately half will have armored vehicles (tanks, IFV's, SAU [self-propelled artillery mounts], SAM systems and so on).

It will require 6-8 hours for a division to move up from the concentration area to the forming-up place for the offensive. NATO specialists believe that this is enough time for an army corps commander to organize and execute several strikes against each group of targets of an advancing division and to accomplish the mission of putting it out of action before it is committed.

Delivery of strikes against regiments in concentration areas, where they will be located for several hours after execution of a march, is considered to be another option for accomplishing missions of this category. Here the regiments will have to perform maintenance on combat equipment, refuel combat vehicles and organize the personnel's rest.

Category III missions are strikes to a depth of 80-150 km against divisions moving up to the front in order to disorganize or contain their forward movement, which will permit weakening elements of the operational alinement of the first echelon large strategic formation. It is planned to deliver strikes against these large units both

on the march as well as in concentration areas. Large and small enemy armored units are considered to be the most important targets of such strikes. The movement of large and small units through this zone may be delayed by 12 hours or more as a result, which will lead to disruption of enemy plans to conduct an operation (battle).

Foreign specialists recommend the following methods of fire effect in this zone: engagement of enemy troops on the march; destruction of enemy units during halts (stops); delivery of strikes against troop concentrations forced to form in chokepoints (defiles). Above all surface-to-surface missile units and subunits and command posts will be priority targets (objectives) for engagement.

In the specialists' opinion, creation of chokepoints on routes of forward movement of enemy troops (destruction of bridges, tunnels, dams) at the moment immediately preceding the large or small unit's approach to this area will be very effective in accomplishing missions of this category. As a result troops will be forced to cease movement. The density of troops and military equipment also may increase, which will be a favorable factor for delivering mass strikes against them.

Category IV missions are strikes to a depth of 150-300 km against the large and small units of large strategic formations in the second echelon with the objective of disorganizing and holding up their forward movement. Delivery of strikes against troops during rail and highway movements as well as in areas of forced stops such as at chokepoints created on their movement axes by destruction of bridges and sections of railroads and highways is considered a general approach to accomplishing missions of this category.

In order to oppose the enemy in carrying out restoration work or organizing new crossings over water obstacles it is considered necessary to conduct surveillance of such areas every 12-24 hours and to deliver repeat strikes against them if necessary.

Category V missions are strikes to a depth of 350-800 km or more against troops of larger strategic formations in the strategic second echelon with the objective of delaying their arrival in the combat zone by 10-20 days after the beginning of an armed conflict.

To accomplish missions of this category it is considered necessary to disrupt the system of rail movements of Warsaw Pact countries by delivering strikes against bridges, route centers, marshalling yards, dispatch points, railroad sections, and electric power stations supplying electrical energy to rail transportation, as well as by mining individual sections. It is recommended repeating strikes every 3-4 days directly against troops of the strategic echelon, and every 10-15 days against installations on transport lines.

The foreign press emphasizes that a thorough analysis by NATO strategists of advantages and drawbacks of various operational plans and options in realizing requirements of the FOFA concept is a many-sided and complex problem. In particular, they draw the following conclusions.

Target selection. The greatest threat for NATO Allied Armed Forces is represented by tanks, which combine mobility, firepower and rather high armor protection. In view of this they are considered priority objects of engagement. Other important targets are armored fighting vehicles (IFV's, APC's, self-propelled artillery) as well as transportation equipment intended for delivering ammunition and fuel. Command and control posts, surface-to-surface missile launchers and SAM systems are categorized as the most important small targets against which strikes should be delivered immediately.

Foreign specialists consider the **basic weapons** which may be used for engaging second echelons (reserves) to be artillery, land-based ballistic missiles, tactical aircraft with precision guided weapons employed in a standoff mode, and long-range cruise missiles.

In the assessment of NATO specialists, at a shallow depth (5-30 km) the enemy troop grouping will be saturated with a considerable number of armored vehicles which are to be destroyed (neutralized, engaged) in accordance with Category I missions. Therefore tube artillery and MLRS [multiple-launch rocket systems] (range of fire up to 40 km) will be very effective in delivering strikes against troops and combat equipment, and massed fire will be the most advisable method of engagement. Preference is given to the use of cluster munitions. Copperhead artillery projectiles have an especially high effectiveness in engaging armored targets.

Foreign military specialists believe that in firing against moving combat vehicles the primary mission is to stop their movement. If possible a column should be held up in a place where vehicles cannot change direction and a stop by one of them can cause the movement of others to cease. One or more artillery subunits can conduct fire simultaneously against various targets on the road. It is believed that such fire can ensure the engagement of a considerably greater part of the combat vehicles with a single strike. The primary advantage of this method lies in the use of organic artillery projectiles (fragmentation-HE, shaped-charge, cluster in various fillings and so on), which permits any army corps or division of NATO forces having the necessary means of acquiring and intersecting targets to deliver such a strike against enemy second echelons (reserves). It is not necessary to organize close coordination among these large units inasmuch as each of them will deliver strikes within the limits of its zone of responsibility.

A feature of the engagement of enemy second echelons (reserves) in a zone of intermediate range (30-150 km) is the fact that NATO troops will have more time to deliver

strikes against the enemy (up to 6-8 hours against a division and 1.5-2.0 hours against a regiment). Because of this there will be no need for an immediate strike against detected large or small units moving up to the front line. In addition, an opportunity presents itself to accomplish the mission of disorganizing enemy troops by delivering strikes against such important troop elements as command posts. There are more favorable conditions for creating chokepoints on the axes of forward movement of large and small units such as by destroying bridges over water obstacles.

Strikes against enemy troops at great depth (150-800 km) will be accomplished primarily by aviation employing precision guided weapon systems of medium (up to 200 km) and long (up to 600 km) range.

In the assessment of foreign specialists, in the near future the U.S. and NATO commands will take new steps in the interests of increasing Allied Armed Forces' capabilities to combat enemy second echelons (reserves). The following measures are expected in particular: retargeting a considerable portion of American strategic bombers (B-52 and FB-111) equipped with precision guided weapons to deliver strikes against installations in the European Theater (in the depth of territories of Warsaw Pact countries); development [razrabotka] of additional means for prompt transmission of reconnaissance data to consumers at the tactical level on a time scale sufficient for organizing engagement of advancing enemy second echelons (reserves); expanding capabilities to provide mutual support of NATO Allied Armed Forces army corps with their adoption of more effective land-based systems including MLRS and in the future the ATACMS missiles (it is planned to launch them from existing and future MLRS launchers; range 150-200 km); procurement of a sufficient number of modern weapon systems (especially such as the MLRS), guided glide bombs, cluster munitions filled with fragmentation and shaped-charge-fragmentation elements, and guided artillery projectiles which can be employed most effectively for strikes against enemy second echelons (reserves).

The foreign press emphasizes that over the next few years the United States and certain other NATO countries will complete development [razrabotka] of several more sophisticated systems which will be employed in accomplishing missions of engaging second echelons, particularly reconnaissance-attack systems, ground surveillance and weapon guidance radars under the JSTARS program, Skeet and SADARM precision cluster antitank ammunition, as well as rockets for the MLRS and new AGM-130 guided air clusters.

It is possible that other precision guided weapons also will appear in the future such as a cruise missile with conventional filling and long flight range (up to 600 km), which is to have a cluster warhead filled with mines and sub-munitions for destroying airfield runways.

The United States is performing research to create [sozdaniye] 155-mm and 203.2-mm projectiles with a solid-fuel ramjet engine which can have a range of fire of 60-80 km.

A more compact and specific combination of personnel and equipment of reconnaissance, control and fire effect is envisaged for missions of engaging second echelons (reserves). The most acceptable combinations of personnel and equipment for delivery (platforms) and of ammunition, including future weapon systems (i.e., reconnaissance-attack systems and rockets), are being considered as possible options for such integration depending on different categories of missions to be performed and on the nature of the target (objective) of engagement (Table 3).

NATO specialists presently are attempting to generalize the theoretical studies and experience of exercises of recent years during which basic questions of the new FOFA concept were worked out. As a result they arrive at the following general conclusions.

1. Realization of the concept must be based on attack capabilities not only of existing precision weapon systems of ground and air forces, but also on future systems.

2. Improved conventional (non-nuclear) FOFA weapons must be deployed in the Central European Theater above all.

3. Precision antitank munitions and means of detecting moving targets are of greatest significance for developing the concept.

4. In FOFA preference must be given to delivering strikes against large and small combat units of enemy ground forces after they leave concentration areas and while moving along roads toward the front line, as well as to creating chokepoints on routes of their forward movement.

5. Special significance should be given to FOFA at a depth up to 100-150 km from the line of contact.

6. Expenses for creation [sozdaniye] and production of new precision weapon systems as well as reconnaissance and communications equipment of ground and air forces of NATO countries to realize the concept's requirements to the full extent tentatively will be at least $50 billion. In the estimate of American specialists, for example, in order to disrupt the forward movement of Warsaw Pact troops in the Central European Theater at a depth of up to 30 km it will be necessary to employ around 4,000 precision guided missiles of various types, and it will require around 10,000 guided missiles in the inventory of ground and air forces for accomplishing the very same mission at a greater depth (up to 300 km).

Mission and Type of Weapon	Means of Delivering Munitions to Target (Platform)	Munitions	Support Systems
	5-30 km from Front Line		
Engagement of regimental level targets by air resources	F-16 tactical fighters	SFW air clusters, Skeet precision-guidance munitions	PLSS recon-attack system, MLRS, F-4G tactical fighters
Engagement of regimental level targets by air resources in standoff mode	Same as above	Air modular weapon systems, Skeet & TGSM precision-guidance munitions	-
Engagement of regimental level targets by rocket weapons	MLRS	ATACMS missiles, Skeet & TGSM precision-guidance munitions	-
Engagement of regimental level targets by artillery systems	MLRS, 203.2-mm howitzers	SADARM and TGSM precision-guidance munitions	-
	30-80 km from Front Line		
Engagement of divisions on march by air resources	F-16	SFW air clusters, Skeet precision-guidance munitions	PLSS, ATACMS missiles
Engagement of divisions on march by air resources in standoff mode	F-16	Air modular weapon system, Skeet & TGSM precision-guidance munitions, combined-effect munitions	Same as above
Engagement of divisions on march by rocket weapons	MLRS	ATACMS missiles, Skeet, TGSM precision-guidance munitions, future dual-purpose projectiles	-
Engagement of targets in regimental concentration areas by air resources	F-16	Air clusters, combination-effect munitions	PLSS, ATACMS missiles, F-4D & F-15 tactical fighters
Engagement of targets in regimental concentration areas by air resources in standoff mode	F-16	Air modular weapon system, combination-effect munitions	PLSS, ATACMS missiles
Engagement of targets in regimental concentration areas by rocket weapons	MLRS	ATACMS missiles, future dual-purpose projectiles	-

In order to reduce losses of NATO tactical aviation in one mass sortie from 13 to 3 percent (with it operating at a depth to 100 km), it will be necessary to employ around 1,800 ATACMS missiles being developed [razrabatyvat] in the United States against enemy SAM systems over a 30-day period.

Mission and Type of Weapon	Means of Delivering Munitions to Target (Platform)	Munitions	Support Systems
	80-150 km from Front Line		
Engagement of enemy troops on march by air resources	F-16	SFW air clusters, Skeet precision-guidance munitions	PLSS, ATACMS missiles, F-4G & F-15 tactical fighters
Engagement of enemy troops on march by air resources in standoff mode	F-16	Air modular weapon system, combination effect munitions	PLSS, ATACMS missiles
Engagement of enemy troops on march by rocket weapons	MLRS	ATACMS missiles, future dual-purpose projectiles	-
Engagement of targets in division concentration areas by air resources	F-16	Air modular weapon system, combination effect munitions	PLSS, ATACMS missiles
Engagement of targets in division concentration areas by rocket weapons	MLRS	ATACMS missiles future dual-purpose projectiles	-
Engagement of enemy troop concentrations at chokepoints by air resources	F-15E & F-16	GBU-15 UAB [guided bomb], air modular weapon systems, combination effect munitions, mines	PLSS, ATACMS missiles
Engagement of enemy troop concentrations in chokepoints by air and rocket weapons	F-15E & MLRS	GBU-15, ATACMS missiles, future dual-purpose projectiles	-
Engagement of control centers and command posts by air weapons	F-16	Air modular weapon systems, cluster munitions	PLSS, ATACMS missiles
Engagement of control centers and command posts by rocket weapons	MLRS	ATACMS missiles, cluster munitions	-
	150-350 km from Front Line		
Engagement of enemy troops on march by air resources	F-15E, F-111 & Tornado	AGM-130B guided bomb, combination effect munitions	PLSS, F-15 tactical fighters
Engagement of enemy troops on march by cruise missiles	B-52 strategic bombers	Air-based cruise missiles, combination effect munitions	-
	350-800 km from Front Line		
Engagement of rail communications by cruise missiles	B-52	Air-based cruise missiles with conventional warhead, remote mining systems	-
Engagement of bridges by cruise missiles	B-52	Air-based cruise missiles with conventional warhead	-
Engagement of enemy troops transported by rail	B-52	Air-based cruise missiles with cluster warhead, combination effect munitions	-

7. Conventional long-range precision weapon systems are of decisive importance for successful realization of the FOFA concept. In this regard the U.S. and NATO commands place main reliance on American strategic bombers, which are to be equipped with Tomahawk cruise missiles with conventional filling with an effective range up to 1,500 km, and in the future with cruise missiles being developed [razrabatyvat] with a range up to 600 km, and on tactical fighters of NATO country air forces.

Thus the adoption in the United States and NATO of new, essentially aggressive concepts aimed against the USSR and other Warsaw Pact countries, wide-scale saturation of troops with various kinds of precision guided systems, and many-sided research to develop more devastating kinds of conventional weapons attest to the fact that reactionary circles of the United States and North Atlantic Alliance are continuing the course toward the arms race with the objective of giving the armed forces a first strike potential employing only conventional weapons.

In this regard USSR Minister of Defense Army Gen D. T. Yazov declared that "we are carefully following U.S. and NATO military preparations, we see and are properly assessing the dangerous trends appearing in this process, and in this connection we are seeing to it that our defense potential is developing in an appropriate manner."

Footnotes

1. For more detail about this concept see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 7, 1984, pp 29-35—Ed.

6904

Command and Control Improvement in Norway

18010332c Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 17-18

[Article by Col V. Oleynikov]

[Text] In addition to improving the armed forces' organizational structure, the country's military-political leadership is giving serious attention to outfitting staffs and large and small units with new automated control systems. For example, under an order from the ground forces command, the Norwegian firm of Kongsberg Vapenfabrikk is developing automated systems for command and control of troops and weapons for the 1990's.

It is planned to develop such automated control systems in three stages. The first stage (begun in 1986) provides for outfitting division and brigade staffs with system elements. The second stage includes installation of gear at existing fixed buried command posts. It is to be carried out within the framework of an overall program for modernizing the command and control and communications system of all higher staffs of the country's armed forces. The final stage consists of equipping subunits with new automated control equipment at the battalion/detached company level.

The beginning of development and deployment of the automated command and control system in ground forces (at the division/brigade level) was chosen so as to have this work coincide with the creation of the Odin-2 automated artillery command and control system. In the opinion of Norwegian military specialists, such unification of efforts will permit using unified units and software in these automated command and control systems and will make the development and adoption of new military equipment cheaper.

The most important purpose for the Odin-2 automated control system will be fire control of multiple-launch rocket system batteries, deployment of which is expected in the first half of the 1990's. Structurally this system will be a complex of data collection, processing, display and transmission equipment. It is planned to install all the gear on the chassis of an M113 APC.

6904

Organized U.S. Army Reserve

18010332d Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 21-27

[Article by Lt Col I. Aleksandrov]

[Text] In continuing a wide set of measures to increase the firepower and attack might of ground forces, the U.S. Army command is devoting much attention to improving their reserves, which are the basis for building up the fighting and numerical strength of large and small units as well as for replacing losses during combat operations. Their importance has grown especially of late in connection with a change in the U.S. command's views on the possible nature of combat operations. In the opinion of American military specialists, under present-day conditions a conventional war can assume a protracted character which will require deployment of additional personnel and equipment; reserves can be used for this, especially in the initial stage of the war. Each side's success can be predetermined back in peacetime by their strengths, level of training, level of outfitting with weapons and military equipment, and capability for rapid mobilization in an emergency.

The American military press notes that the organized reserve including the Army National Guard and the Army Reserve (U.S. Army reserve components) is the best trained part of ground forces reserves. Organizationally, reserve component personnel are placed together in establishments, large and small units, and subunits outfitted with weapons and military equipment and have a mobilization and operational assignment. The National Guard provides a basis for training, mobilizing and transferring large and small units and subunits to the Regular Army. The Army Reserve is intended for accomplishing these same missions and for expanding the mobilization training base for training the personnel needed both for replacing losses and for activating new large and small units.

In the 1970's the American command viewed reserve components as a second echelon of the strategic reserve (the first echelon is the grouping of regular ground forces in the continental United States) intended for subsequent reinforcement of friendly troops deployed in overseas TVD [theaters of military operations]. Based on the possibility of conducting conventional wars in different theaters, the American command presently plans to use large and small units of reserve components in all phases of reinforcement of American forward troop groupings. It is planned to mobilize a portion of reserve formations and move and deploy them in areas of their operational assignment considerably earlier than certain regular units and subunits. Therefore, foreign military specialists believe that the primary mission assigned to reserve components during mobilization deployment of ground forces is the preparation of reserve formations for movement to overseas theaters and for their participation in ground operations in these theaters.

Direction of the organized reserve is exercised by the Secretary of the Army through an assistant for manpower and reserve affairs and through the Army Staff. The assistant in turn is responsible for manning of the National Guard and Army Reserve, organization of combat training, and medical support, while the Staff exercises direction through the Chief of the Army Reserve and Chief of the National Guard Bureau.

The Chief of the Army Reserve is responsible for the manning of Reserve units and subunits, outfitting with weapons and military equipment, planning of combat training, as well as advancement and promotions of reservists in service.

The Chief of the National Guard Bureau (the Bureau is under the Army Staff and is a unified management entity for the Army and Air Force National Guard) is responsible for organizational development and tactical employment of its formations. The foreign press notes that a feature of the National Guard is its peacetime subordination to the administration of corresponding states, by decision of which "national guardsmen" can be used to fight a strike movement, protect government and private property, mop up in the aftermath of natural disasters (earthquakes, fires, floods) and so on. National Guard formations are transferred to the Army command only in case a national state of emergency is declared or with the beginning of a war. That procedure limits the range of missions assigned to the National Guard Bureau and Department of the Army in peacetime. In particular, the National Guard Bureau is responsible for organizational development, organization of combat training, logistic support, as well as liaison among government establishments and state administrations, while the Department of the Army is responsible for exercising overall leadership and for monitoring the elaboration of combat training programs and plans for employing National Guard formations.

The **fighting strength of the organized reserve** makes up a considerable part of the ground forces. Data published in the American periodical press describing the fighting and numerical strength of the National Guard and Army Reserve are given in the table.

American military specialists note that the organized reserve concentrates around 50 percent of the personnel, over 30 percent of combat divisions, 100 percent of training divisions, around 80 percent of separate brigades, up to 60 percent of separate armored cavalry regiments, and approximately 50 percent of special forces groups. At the same time the fighting strength of reserve components does not have the medium range and operational-tactical missile units and subunits which make up the basis of firepower of the ground forces. In addition, they do not have such airmobile units as an airborn division and air assault division. At the same time, the fighting strength of the organized reserve includes a number of formations absent from the Regular Army such as separate antitank battalions and the separate Roland II surface to air [SAM] battalions.

Organized reserve formations are stationed as separate subunits (battalions, companies, platoons) on a territorial basis with consideration for the interests of state authorities, depending on the reservists' residence and presence of a training facility. The American military press reports that National Guard personnel are placed in 3,400 company/platoon level subunits stationed in 2,600 of the country's populated points. The Army Reserve has around 3,200 subunits of this type. They are stationed in all states as well as the District of Columbia, on the island of Puerto Rico and in the Virgin Islands. The 35th Mechanized Division is stationed on the territories of five states; the 47th Infantry Division on three; the 26th and 38th infantry divisions, 29th Light Infantry Division and 50th Armored Division on the territories of two states; and the 28th and 42d infantry divisions, 40th Mechanized Division and 49th Armored Division on the territory of one state. Each of the separate brigades as well as armored cavalry regiments are within the limits of one state, but even in this case their subunits are dispersed over a large territory. For example, one battalion of a separate infantry brigade stationed in Oklahoma is scattered over an area of around 10,000 km^2.

Size, Fighting Strength, Materiel	National Guard	Army Reserve	Total
Personnel, thousands	About 450	Over 300	Over 750
Divisions:	10	-	10
Armored	2	-	2
Mechanized	2	-	2
Infantry	5	-	5
Light infantry	1	-	1
Training divisions	-	12	12
Separate brigades:	18	3	21
Armored	3	-	3
Mechanized	6	1	7
Infantry	8	1	9
Light infantry	1	1	2
Separate armored cavalry regiments	4	-	4
Special forces groups	2	2	4
Tanks	About 3,500	200	About 3,700
Including:			
M1 Abrams	230	-	230
M113 APC's	3,000	300	3,300
155-mm howitzers (M109 and M198)	850	100	950
AH-1F Cobra-TOW fire support helicopters	200	-	200

A number of American sources note that this system of stationing reserve formations causes certain administrative difficulties for higher headquarters and has a negative effect on combat training, especially in holding exercises at the brigade level and on up.

Mobilization of organized reserve formations. Personnel assembly points and mobilization points are specified for all reserve formations. Assembly points are places where personnel assemble for the alert of up to and including a battalion. As a rule weekly combat training classes are held with the personnel on Saturdays at these same points. These subunits' headquarters are located at these points for better management of the subunits; the headquarters usually are stationed in military compounds of Regular Army subunits (units). Reservists' organic small arms are stored here as well in rooms specially set aside for this. If there are no large or small regular units in the immediate vicinity of the reserve formation's location, then special rooms and territory are assigned for conducting combat training classes and these become the personnel assembly points in mobilization. In this case organic small arms are stored in the nearest regular military unit. If there are no such units at all at the reserve formation's location, small arms are stored at this subunit or unit's mobilization point.

Mobilization points are the principal place for holding final mobilization measures of large and small units and separate subunits, for combat teamwork training, and for preparation for movements to overseas theaters of military operations. Arsenals of heavy weapons and military equipment are located on the territory of these points and are issued to the personnel in a period of reserve component deployment as well as when exercises and maneuvers are held.

In general the process of mobilizing and preparing reserve formations for combat operations can be as follows. After the President (or Congress) makes the decision to conduct mobilization an alert is declared for all organized reserve personnel. Reservists gather at assembly points. The personnel are notified by telegraph and telephone channels of communication, messenger, notices in the mail, and using radio and television

resources. After completion of mobilization measures at assembly points (the principal measures are to bring reserve formations up to strength in personnel and draw authorized small arms and material-technical stores if kept at this point), organized reserve units and subunits begin moving out to mobilization points. After drawing heavy weapons and military equipment here, reserve formations are considered mobilized and can begin conducting combat teamwork training of subunits and units up to and including brigade. On completion of these measures the large and small reserve units and subunits are considered ready for subsequent employment.

Employment of the organized reserve. The foreign press reports that the American command has adopted the Capstone program for more effective use of large and small units and subunits of the organized reserve. This is a plan for distributing all regular and reserve army formations by zones of responsibility at U.S. Armed Forces unified commands. In accordance with this program all large and small units and subunits of the organized reserve have an operational purpose determined by the features of their tactical employment and by the make-up of forward groupings of American troops (to be reinforced or newly deployed in overseas theaters of military operations). For example, the Reserve 187th Separate Infantry Brigade in the state of Massachusetts is earmarked for reinforcing the NATO OVS [Allied Forces] and can be moved to Iceland, and the National Guard 53d Separate Infantry Brigade stationed in the state of Florida is planned for employment in Central America, particularly in the Panama Canal Zone.

There is also the so-called Affiliation program intended for raising the combat and mobilization readiness of reserve formations. Under this program a portion of the National Guard and Army Reserve formations are attached to large and small regular units on a territorial basis and during mobilization deployment they are used for bringing the regular units up to strength under wartime T/O&E's. The formations of reserve components included in this program are manned, outfitted with weapons and military equipment, brought in for joint exercises with regular troops, and are familiarized with overseas theaters of military operations before other formations.

Reserve formations included in the Affiliation program are divided into two categories according to their level of combat and mobilization readiness as well as operational purpose. The first category includes only those reserve units and subunits earmarked for bringing large regular units up to strength under wartime T/O&E's. This category includes five separate brigades and several separate combat battalions. For example, during mobilization deployment the National Guard 48th Separate Mechanized Brigade will bring the Regular Army 24th Mechanized Division, which in peacetime has two brigades, up to strength. A similar function is performed by the 256th Separate Mechanized Brigade with respect to the 5th Mechanized Division, and by the 155th Separate Armored Brigade with respect to the 1st Cavalry Division. The second category includes separate brigades (four) earmarked for reinforing Regular Army divisions in case they are moved to overseas theaters of military operations. The third category includes those formations earmarked for combat support and combat service support of large and small regular units. The Affiliation program takes in only a portion of reserve formations, and work presently continues to expand the number of organized reserve units and subunits earmarked for bringing large and small Regular Army units up to strength.

Organizational development of the organized reserve. The fundamental principle of U.S. Army organizational development is the concept of "unified forces," which spells out the most effective ways and methods of using human, materiel and financial resources to maintain the requisite combat and mobilization readiness of the Regular Army and reserve components as a single whole. Realization of this concept reduces to the unified planning and financing of such processes as manning, outfitting with weapons and military equipment, and combat training as well as to a determination of unified criteria of combat and mobilization readiness of troops and organized reserves in the interests of accomplishing missions stemming from war plans. Judging from foreign military press announcements, in accordance with these provisions the American command is making considerable efforts to improve the combat and mobilization readiness of reserve components, above all by their manning, outfitting with weapons and military equipment, and intensification of the process of unit and subunit combat and operational training.

Manning. In connection with the shift of U.S. Armed Forces to a volunteer principle of manning there was also a change in the system of manning the ground forces, including the organized reserve. Presently recruitment of personnel for the National Guard and Army Reserve is done by recruiting volunteers on a territorial basis. A contract concluded initially for a term of up to six years with subsequent extension (if desired) every three years serves as the basis for paying a reservist's salary.

U.S. citizens (men and women) are recruited for the National Guard and Army Reserve in ages from 17 to 59 if they previously performed military service, and up to age 35 if they did not perform such service. Officer personnel slots are filled chiefly from former regular servicemen and graduates of reserve officer training courses at civilian higher educational institutions. In addition, some organized reserve officers are trained at officer candidate schools from among privates and NCO's of reserve components. Slots for NCO and rank-and-file personnel are filled in turn from reservists who extended contracts in the organized reserve, servicemen of regular troops released from active duty and obligated by contract to serve out their term of duty in a reserve formation, former servicemen who expressed a desire to

serve in the National Guard or Reserve, as well as persons who previously were not on military duty and decided to sign up for service in the organized reserve.

After enlisting in the organized reserve, persons who previously have not served in the Army are sent for courses of instruction at an Army training center, where they go through a basic military training course and specialty training lasting at least three months on an equal basis with new recruits. After completion of training the reservists return home and are brought in for combat training as part of the units and subunits to which they are attached in accordance with established rules.

The foreign military press reports that the organized reserve strength presently exceeds 750,000 persons, including around 450,000 in the National Guard and over 300,000 in the Army Reserve. The level of personnel manning is rather high, 90-95 percent. In recent years the American command has been placing great emphasis on the so-called permanent party of the organized reserve; it keeps over 40,000 reservists in large and small units and subunits in order to maintain their combat and mobilization readiness at the requisite level. The primary missions of the permanent party are management, support, maintenance, and conducting combat training. This category of personnel includes command and instructor personnel as well as logistic support and equipment maintenance specialists.

Outfitting with weapons and military equipment. The western military press notes that outfitting of National Guard and Army Reserve large and small units with materiel was being done not long ago with obsolete models of weapons and military equipment turned over from the Regular Army. Lately however the American command has revised its views inasmuch as provisions of the "unified forces" concept envisaged joint tactical employment of regular and reserve formations. In connection with this, those subunits and units earmarked for reinforcing forward groupings of American troops in overseas theaters of military operations are equipped with modern materiel before others.

At the present time considerable efforts are being made to renew the organized reserve's inventory of armored equipment. M1 Abrams tanks, M2 Bradley infantry fighting vehicles and M3 combat reconnaissance vehicles are being received by large and small National Guard and Army Reserve units. Four National Guard tank battalions earmarked for combat operations as part of Regular Army units already have been equipped with new tanks (60-63 tanks in each). Reserve formations also are receiving the M60A3 tanks. In the assessment of American specialists, significant deliveries of these tanks will ensure fulfillment of the tank replacement program and the presence of only these two types of vehicles in reserve components in the early 1990's.

A broad set of measures is being carried out to upgrade air defense. New Chaparral SAM systems and Stinger shoulder-fired SAM systems are coming to replace obsolete antiaircraft mounts, and deliveries of modern air defense artillery systems are planned. The possibility of forming separate Improved Hawk SAM battalions in the organized reserve is being considered.

The helicopter inventory also is being modernized. While the organized reserve did not have a single fire support helicopter in the early 1980's, at the present time some 200 AH-1S Cobra TOW helicopters already have been delivered to the National Guard. In the next few years it is planned to activate an antihelicopter subunit in the National Guard outfitted with modern AH-64A Apache helicopters. CH-47 Chinook assault transport helicopters, UH-60 Black Hawk multipurpose helicopters and OH-58 Kiowa reconnaissance helicopters are being delivered along with combat helicopters.

Combat and operational training of the organized reserve is done in accordance with the "unified forces" concept, which provides for bringing the effectiveness of National Guard and Army Reserve formations up to the level of regular formations. The primary forms of training are the following: training reservists at formations' permanent locations (assembly points) during the year (a total of 48 four-hour classes), three-week courses of instruction, troop exercises and command and staff exercises.

The main requirement placed on the reservist's combat training level is his or her confirmation of professional training in a military occupational specialty. During weekly classes, usually held on Saturdays at assembly points, reservists engage in drill, special, weapon and tactical training as part of small subunits under instructors' direction. Emphasis in combat training is placed above all on tactical teamwork training of subunits at the squad-platoon level. In addition to a study of military disciplines, the training course includes practice of such lessons as mopping up in the aftermath of natural disasters, breaking up street demonstrations and so on.

Lessons of tactical teamwork training of reserve formations at the company-battalion level basically are worked during the three-week courses organized at Army training centers or at the facilities of large and small regular units. Noting the increased role of this form of combat training for reserve formations, American military experts emphasize that lately there has been a considerable increase in the number of organized reserve units and subunits taking part in these courses. For example, while only one company attended them in 1982, there were 30 companies and 16 battalions in 1986. Each year up to five battalions (infantry, mechanized, tank) undergo combat training at the Army National Training Center at Fort Irwin, California. Lately, with consideration of the need for annual training of a large number of subunits of this type, a national guard training center has been under construction at Fort Dix, New Jersey, intended for conducting tactical exercises.

Judging from foreign press materials, reservists are being included more and more often of late in Army exercises taking place both in the continental United States and in overseas theaters. Problems of ensuring the subunits' readiness for rapid mobilization, movement to overseas theaters, and conduct of joint combat operations there are practiced during such exercises. It also has been reported that each year around 750 National Guard subunits, mobilized and moved to the area of their combat assignment together with regular troops, are used for such exercises. A total of almost 22,000 reservists took part in American exercises in Western Europe, South Korea, Japan, Central America and the Near East. Army Reserve subunits (around 650 formations of different levels) also were brought in for these exercises.

In recent years the American command has begun to devote much attention to training individual categories of reservists. The so-called Captain program is being implemented under which National Guard officers (in the category of company commander) are sent for OJT to regular troop units stationed in overseas theaters. Two-week courses have been organized for tank crew commanders at the Armor Center in Fort Hood, Texas, completed by over 800 reservists in 1985 alone. The question of organizing similar courses for certain other categories of reservists as well is being considered.

6904

The Dutch Army

18010332e Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 27-29

[Article by Lt Col I. Mishin]

[Text] Being a member of the NATO bloc, the Netherlands takes an active part in all measures aimed at further building up its military potential. For example, the country's leadership views NATO membership as the basis of its security and structures its military-political course in accordance with decisions made within this organization's framework. According to its obligations, the overwhelming portion of Dutch Army combat units is earmarked for transfer to NATO Allied Forces in Europe, and operational and combat training of staffs and troops is done with consideration for the NATO command's requirements and plans. Organizational development of the Army also is accomplished within the framework of bloc coalition strategy providing for a build-up in its military might through outfitting with modern kinds of weapons and military equipment, an improvement in command and control and communications, and an improvement in the organization and establishment of units and subunits. A ten-year Armed Forces development program (1987-1996) is aimed at implementing these requirements.

The Army (67,000 persons) is the primary branch of the Dutch Armed Forces. It is directed by a chief of the main staff (who also is the commander in chief), who is responsible for the status and the combat and mobilization readiness of the Army and for developing plans for the Army's organizational development and tactical employment. It is divided into combat forces and territorial troops according to their specific purpose.

Combat forces are to be transferred to the NATO Allied Forces in the Central Europe TVD [Theater of Military Operations] in wartime and include large and small units and subunits of I Army Corps.

The *I Army Corps* (headquarters at Apeldoorn) is an operational-tactical formation of the Army intended for conducting combat operations as part of Northern Army Group in the Central European Theater. It has three mechanized divisions (1st, 4th and 5th), the 101st Separate Infantry Brigade (nucleus), units and subunits of corps subordination, a Lance guided missile battalion (six launchers), two separate field artillery groups (nine artillery battalions), one air defense artillery group (five air defense artillery battalions), separate battalions (mechanized, reconnaissance and military police), an army aviation group (72 helicopters), and support and service units and subunits. The corps has 468 Leopard-1A4 tanks and 445 Leopard-2 tanks, over 600 field artillery pieces and mortars, over 700 TOW and Dragon antitank guided missile launchers, 95 35-mm Gepard self-propelled antiaircraft mounts and around 100 helicopters.

The bulk of corps forces and resources is stationed on Dutch territory. There is a tank brigade and separate reconnaissance battalion from the 4th Mechanized Division (a total of around 5,000 persons) in the FRG. According to foreign press data, corps numerical strength in peacetime is almost 40,000 persons, and it is planned to increase this to a maximum of 90,000 after mobilization measures are taken.

It is planned to bring the Army corps and divisions up to full T/O&E's in personnel during time of war as well as for the period of exercises. In peacetime the mechanized and tank brigades and units and subunits of corps and division subordination are directly subordinate to corps headquarters. For convenience of command and control and effective combat training, corps units are put together into separate groups by combat arm (artillery, air defense artillery, engineer, signal, transport, medical).

The *mechanized division* is the highest Army tactical unit intended for conducting combat operations both as part of the Army corps and independently. It includes two mechanized brigades and a tank brigade, and combat support (a battalion of Gepard self-propelled air defense mounts—27 launchers—and a reconnaissance battalion) and combat service support subunits. With the beginning of combat operations or for an exercise period the

division may include one or two artillery battalions, an air defense artillery battalion, engineer battalion, medical battalion and other support and service subunits from corps groups. The full-strength mechanized division has around 17,000 persons, up to 250 Leopard-1A4 and -2 tanks, over 100 field artillery pieces and mortars, 200 TOW and Dragon ATGM launchers and other materiel.

The *mechanized brigade* (over 4,000 persons) consists of two mechanized battalions and a tank battalion, an artillery battalion and three companies (antitank, reconnaissance and signal). The brigade has 61 Leopard-1A4 tanks, 18 M109A2 155-mm self-propelled howitzers, 84 ATGM launchers, and around 300 infantry fighting vehicles and APC's.

The *tank brigade* (over 3,500 persons) includes two tank battalions, a mechanized battalion and an artillery battalion. It has 108 Leopard-2 tanks, 18 155-mm self-propelled howitzers, 30 ATGM launchers, and over 100 infantry fighting vehicles and APC's.

The mechanized battalion of the mechanized and tank brigades (800 persons) consists of a headquarters and support company and two mechanized companies. It has 42 ATGM launchers, 9 120-mm mortars, and over 60 infantry fighting vehicles and APC's.

The tank battalion (500 persons) is outfitted with 61 Leopard-1A4 tanks (in the mechanized brigade) or 54 Leopard-2 tanks (in the tank brigade).

Territorial troops are a component part of the Army and subordinate to the Army commander in chief through the staff of the National Territorial Command in Gauda (25 km east of the Hague). They are intended for accomplishing the following missions: support to mobilization deployment of the Armed Forces, security and defense of important military and civilian installations, MTO [logistic support] and organization of communications in the interests of the I Army Corps. In a period of threat and with the beginning of combat operations the primary missions of territorial troops will be to support the operational deployment of Armed Forces and the movement of NATO partners' troops across the country's territory.

The structure of territorial troops conforms to the country's military-administrative division. The National Territorial Command headquarters has 11 subordinate provincial territorial commands (districts), as well as commands for communications, logistics, medical, training, and personnel replacement and training (established in wartime).

The *provincial territorial commands* have headquarters and support subunits. There are 60 mobilization complexes and staffs of national reserve subunits subordinate to them. The commands carry out the call-up for military service, hold exercises with territorial troop subunits, and carry out mobilization measures.

In wartime it is planned to deploy two infantry brigades, three separate infantry battalions, one transport battalion as well as two combat and combat service support groups as part of the National Territorial Command. Overall personnel strength of the National Territorial Command ten days after declaration of mobilization in the country should be over 40,000 persons, and in 20 days it should be around 70,000.

The *Communications Command* is responsible for the military communications network on the territory of the Netherlands, for organization of communications of Dutch units and subunits on the territory of the FRG, and for communications of the military leadership with NATO staffs. It has three signal battalions.

The *Logistic Command* is responsible for depots and repair workshops for weapons and military equipment, as well as for logistic support of I Army Corps troops.

The *Medical Command* organizes medical support to ground troops and includes three medical groups made up of battalions.

The *Training Command* performs missions of training personnel for combat forces and territorial troops. Each year over 40,000 servicemen undergo training in its training centers.

As the foreign military press reports, the Dutch Army inventory has a total (counting what is at depots) of 6 Lance guided missile launchers, around 1,000 Leopard-1A4 and Leopard-2 tanks, almost 750 M113 APC's, over 700 YP-408's (planned for removal from the inventory prior to 1989), approximately 1,500 YPR-765 infantry fighting vehicles, 42 M101 105-mm towed howitzers, 140 M114 155-mm howitzers, 218 M109A2 155-mm self-propelled howitzers, 76 M110A2 203.2-mm self-propelled howitzers, around 600 mortars of various calibers, over 700 TOW and Dragon ATGM launchers, 95 Gepard 35-mm self-propelled air defense mounts, 54 L70 40-mm antiaircraft guns, and around 100 Alouette III and BO 105 army aviation helicopters.

Prospects for organizational development. A ten-year plan for development of the Dutch Armed Forces provides for increasing the Army's striking power and combat readiness while preserving the existing personnel strength and quantity of weapons and military equipment. Priority attention is given to questions of increasing the mobility and firepower of large and small units as well as ensuring reliability, flexibility and stability of command and control, air defense, electronic warfare and logistic support. In addition, it is planned to carry out a number of measures with the objective of shortening time periods for operational deployment of the I Army Corps.

In 1988 it is planned to complete modernization of the Leopard-1A4 tanks in the inventory of mechanized brigades. Outfitting of mechanized battalions with the

YPR-765 infantry fighting vehicles is continuing and should be completed by the beginning of the 1990's. Much attention in the Army military organizational development program is given to increasing the tactical capabilities of artillery. The M114 155-mm howitzers are being modernized; on completion of modernization they will be able to fire nuclear ammunition. Reorganization of artillery battalions of 155-mm self-propelled howitzers of mechanized and tank brigades has begun, as has that of battalions of 203.2-mm howitzers of corps subordination with the objective of increasing the number of pieces in them. An agreement was concluded with the United States for purchasing the MLRS multiple launch rocket system (two batteries of nine launchers each are planned to be activated in 1989). Development is under way on a new automated fire control system which will be delivered to the troops in the early 1990's. According to the plan, by this time surveillance radars and reconnaissance drones will be accepted in the inventory.

Beginning in 1988 it is planned to begin introducing the Zodiac automated communications system to the troops; in the opinion of western specialists, this will increase reliability of communications and ensure an increase in the volume and rate of information transmission and a high degree of security. An automated data processing and distribution system also will be adopted.

It is planned to reorganize troop air defense by disbanding AAA battalions of 40-mm AA guns and introducing Stinger shoulder-fired SAM subunits to mechanized companies and to battalions of Gepard self-propelled air defense mounts. The effectiveness of Army air defense also is to be increased by adopting the Patriot SAM system in place of the Nike-Hercules. The first Patriot SAM battery (five launchers) was activated as part of the Air Force in April 1987 and is in the FRG.

The Armed Forces development program envisages the adoption of up to 80 new combat helicopters in place of obsolete ones in Army aviation. The possibility of purchasing A.129 Mangusta antitank helicopters of the firm of Agusta (Italy) or new combat helicopters of Franco-West German production during 1990-1992 is being considered.

Modern weapons and military equipment will be delivered first to troops stationed in the FRG. The question of redeploying the 4th Mechanized Division headquarters to the FRG is being considered for the purpose of increasing I Army Corps combat readiness.

In the opinion of foreign military specialists, the above measures can substantially increase the Dutch Army's tactical capabilities and will contribute to an increase in its striking power and firepower.

6904

Infantry Fighting Vehicles

18010332f Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 30-35

[Article by Col B. Safonov, candidate of technical sciences]

[Text] All weapons of warfare are being improved in the course of military preparations abroad, and in NATO countries above all. Infantry fighting vehicles [IFV] hold an important place in ground forces. The first models of these vehicles were adopted in the 1970's and presently have become widespread.

Foreign military specialists view the IFV as a means of combat and transportation for the infantry squad intended to increase infantry's fire capabilities, provide it with mobility under conditions of combat activities, and give it protection against small arms fire and the fragments of artillery and mortar rounds. IFV's must carry out close and continuous coordination with other weapons of the ground forces, and with tanks above all.

Tracked and wheeled APC's in the inventory had an insufficient level of protection and their armament basically was designed for self-defense.

The FRG was the first NATO country to begin developing an IFV. The essence of the West German concept of the IFV is as follows. The IFV is not a reinforced APC but a new combat weapon. The infantry basically must fight in IFV's, dismounting only in those cases where it is impossible or inadvisable to use these vehicles. It is emphasized that the tank and IFV are fighting vehicle partners operating in the same combat formation and distributing combat missions among themselves in an optimum manner. To ensure the possibility of such use the IFV must have an increased level of protection close to that of the tank and must have effective armament. Conditions must be created permitting riflemen to use their personal weapons. Realizaton of this concept led to creation (in the late 1960's) and adoption of the **Marder** IFV in the Bundeswehr inventory. A total of over 2,100 of them have been delivered.

The Rh-202 20-mm automatic gun with double-belt feed installed in an above-turret mount is used as the main armament of this nonamphibious vehicle. A 7.62-mm machinegun is coaxial with it. A low-profile turret accommodates the vehicle commander and gunner, who have redundant weapon control drives. The Marder IFV armor was designed for protection against projectiles of small-caliber cannon and the fragments of large-caliber artillery and mortar rounds. The vehicle's high mobility is provided by use of a six-cylinder 600 hp diesel engine, hydromechanical transmission, individual torsion-bar suspension with telescopic hydraulic shock absorbers, and tracks with rubber-metal articulated joints.

The Marder IFV assault group can fire from the vehicle through four ports (two on each side), and the assault group commander from a 7.62-mm machinegun with remote control installed on the hull roof plate.

The Marder IFV was modernized in the early 1980's, chiefly to increase firepower by improving day and night vision devices, surveillance devices and aiming devices as well as the mount of the detachable Milan ATGM, and by strengthening protection against conventional weapons and weapons of mass destruction (Fig. 1 [figure not reproduced]). The vehicle's weight then increased to 30 tons.

A design analysis was performed and models of the Marder IFV were manufactured and tested with a 25-mm automatic gun, for which a finned composite shot of increased power was created. A vehicle with the LWT-3 turret stabilized in three planes of laying (armed with a 20-mm automatic gun) also underwent tests.

In 1985 the FRG Ministry of Defense announced a change in nomenclature of armored fighting vehicles being developed for the Bundeswehr for the 1990's. Among the priority projects is creation of a new infantry fighting vehicle which should be delivered to the ground forces in 1996. The overall requirement for such vehicles is estimated at 2,500. It is possible that this will be a completely new model, although the probability of further development of the Marder IFV also is not precluded. There are proposals to develop a new IFV based on the Leopard-1 and Leopard-2 tanks.

The **AMX-10P** (Fig. 2 [figure not reproduced]) light amphibious IFV was adopted by the French Army in 1973. The M693 20-mm automatic gun and coaxial 7.62-mm machinegun are mounted in the above-turret mount. The welded aluminum alloy hull provides protection only against small arms. There are hatches in the hull roof plate from which infantrymen can fire. There are no side ports.

A water-cooled multifuel Hispano-Suiza 280 hp diesel engine, hydromechanical transmission, individual torsion-bar suspension and tracks with rubber-metal articulated joints are installed on the vehicle. On the whole the AMX-10P is close in design to the traditional APC, differing only in the more powerful armament. The vehicle is a base for a family of wheeled and tracked models with various military purposes.

The United States began developing its own IFV later than its West European partners in NATO. American specialists believe that infantry can perform their combat missions only by operating in dismounted formation and it is advisable to deliver the infantry to the battlefield in relatively inexpensive APC's ("combat taxis"). Moreover the United States had a large inventory of such vehicles. It was also believed that some of these vehicles can be adapted for performing missions assigned to IFV's if necessary.

After rather lengthy research and development , an IFV model later designated the AIFV was created on the basis of the M113A1 APC by the beginning of the 1970's. The vehicle was not adopted by the U.S. Army, but after modification it was purchased and manufactured under license in Belgium and the Netherlands, and was designated the YPR-765 in the Dutch Army (Fig. 3 [figure not reproduced]). A total of some 1,500 such IFV's and various vehicles based on it were delivered to the Dutch Army. It accommodates spaced hull and turret armor. A 25-mm automatic gun and coaxial 7.62-mm machinegun are installed in a single-place armored turret. Development of the **M2 Bradley** IFV for the American Army began in 1972. It was intended for joint operations of infantry with tanks as part of mixed tank-infantry groups in a war of any intensity. Mechanized infantrymen in IFV's help tanks detect and destroy antitank weapons and cut off enemy infantry from tanks, and facilitate the negotiation or bypass of obstacles by tanks. In the offensive infantrymen in IFV's approach the forward edge as close as possible using the maneuverability, protection and fire of their own weapons as well as fire support of artillery. They dismount and fight in dismounted formation only when further advance in the vehicle becomes impossible.

Although American specialists began developing the infantry fighting vehicle back in the mid-1960's, the M2 Bradley IFV (Fig. 4 [figure not reproduced]) was adopted by the U.S. Army only in 1981. It is planned to deliver a total of around 3,600 to the Army.

A 25-mm automatic gun with external automatic chain drive stabilized in two laying planes is installed in the IFV's two-place armored turret. A 7.62-mm machinegun is coaxial with it. A twin launcher for the TOW ATGM is mounted on the turret. Launcher reloading is done from inside the vehicle through a special hatch. The vehicle hull and turret are made of armor based on aluminum alloys, with the most important components locally reinforced with steel armor plates of great hardness. Side components of the hull are made in the form of a spaced design, with intervals between steel plates and load-bearing aluminum hull filled with polyurethane foam.

The engine and transmission compartment is located in the front part of the hull. The eight-cylinder engine is connected with a hydromechanical transmission. Suspension of the running gear is torsion-bar with a large drive wheel assembly, and the tracks have detachable rubber pads. Water obstacles are crossed afloat at a speed of 7 km/hr (by turning the tracks).

The first lots of the Bradley IFV were delivered to the U.S. Army in 1982. After that a program for phased modernization was developed. Since May 1986 the machine has been produced with the M2A1 notation. Measures for its first-phase modernization include use of a new twin TOW ATGM launcher permitting missiles of all modifications including the TOW-2 to be fired; an

improvement in gun design (barrel lengthened and breech reinforced); use of additional hull and turret armor employing new materials and possibly dynamic protection; and a change in the pressurization and purified air delivery system with the objective of protecting the crew against chemical and bacterial agents as well as against radioactive dust. Purified air is delivered to the three crew members by a ventilation filter unit, and the six riflemen of that part of the team to dismount must use individual protective gear if necessary.

Subsequently additional measures are planned to increase survivability, including reconfiguration of the power plant fuel supply system and a change in accommodation of ammunition stowage (by removing ammunition for the 25-mm gun, TOW-2 missiles and all pyrotechnic equipment from the manned compartment behind supplementary armor protection). It is planned to localize the behind-armor effect of fragments by supplementary internal armor protection, including use of kevlar material.

The tracked Trojan APC has been the basic means of infantry transport in the British Army to this date. Production began in 1986 on the **MCV-80 Warrior** infantry fighting vehicle (Fig. 5 [figure not reproduced]), created by the firm of GKN Sankey. It is planned to purchase a total of 1,048 machines, of which around 30 percent will be different versions based on that IFV (command and staff, repair-recovery and engineer vehicles, 81-mm self-propelled mortar, self-propelled ATGM system, and mobile artillery command posts).

The British IFV is similar in configuration to the American M2 Bradley. The engine and transmission compartment occupies the right front portion of a welded hull made of aluminum armor. The two-place turret is made of steel plates with filler between them. The Rarden 30-mm automatic gun and coaxial 7.62-mm machinegun are mounted in the turret. The gun can fire armor-piercing discarding-sabot and fragmentation-high explosive shells.

The MCV-80 Warrior IFV is equipped with a V-8 diesel engine mounted in the same block with the automatic hydromechanical transmission. Running gear suspension is torsion-bar. The vehicle is nonamphibious and is equipped with a ventilation filter unit.

Other capitalist countries also are working to create infantry fighting vehicles. For example, prototypes of the **VCC-80** IFV (Fig. 6 [figure not reproduced]) already have been demonstrated in Italy. Its hull and turret are made of aluminum armor with steel plates reinforcing the hull front section. A 25-mm automatic gun is mounted in the two-place turret. The hull sides have ports for firing small arms.

The **"88"** IFV presently being developed in Japan will be armed with the Oerlikon 35-mm automatic gun and ATGM launchers (with laser guidance system). It is also planned to use combination armament (a 40-mm gun and RBS-56 Bill ATGM system) in a Swedish infantry fighting vehicle, with beginning of prototype tests planned for 1988.

Production of the **KIFV** infantry fighting vehicle has been adjusted in South Korea, with more than 100 units already delivered to the ground forces. Outwardly this vehicle resembles the American AIFV. Its design made extensive use of assemblies and machine units of foreign armored vehicles.

The Argentine **VCTR** IFV was developed on the basis of the West German Marder IFV.

The Swiss **Tornado** IFV remained in the prototype stage.

The table gives principal tactical-technical characteristics of IFV's of foreign armies.

Judging from foreign press materials, IFV development abroad has proceeded chiefly with an eye toward creating light vehicles having an appropriate level of protection for an infantry squad. Western military specialists highlight certain trends in this development.

First of all, an increase in weight dictated by the need to improve protection was seen in the vehicles. It is noted that although a certain increase in weight in nonamphibious IFV's leads to reduced mobility indicators, it does not cause great complications. For the amphibious vehicles (such as the M2 Bradley), however, this involves loss of buoyancy and requires introducing supplementary devices to the design engendering new problems connected with reliability, combat readiness, maintenance and supply difficulties and so on.

Secondly there is an increase in calibers of automatic guns being used as main armament. This causes an increase in vehicle size and deterioration of conditions for accommodating the combat team.

Thirdly an attempt is seen to free the IFV of the mission of mandatory combat against enemy tanks and place this mission on other specialized vehicles.

Fourthly an attempt to make best use of the numerous effective weapons installed on the IFV leads to a decrease in number of dismountable personnel and an increase in nondismountable personnel of the vehicle combat team.

Attention also is drawn to the fact that up until now distinguishing features of the IFV as a class of armored equipment have not been determined with sufficient completeness and clarity abroad. This reflects to a certain extent an absence of uniformity among western experts in an understanding of the purpose, role and place of the IFV in the system of ground forces' armament. Moreover, some believe that the desire to improve infantry's fighting capabilities by improving light

Model Name (Developing Country, Year Adopted)	Combat Weight, tons	Crew / Combat Team	Dimensions, m: Height / Length x Width	Weapon Caliber, mm: Gun / Machineguns	Engine Output, hp	Maximum Speed, km/hr / Range, km
Marder (FRG, 1971)	28,2	3/7	2,8 / 6,8 x 3,2	20 / 2 x 7,62	600	75/500
AMX-10P (France, 1973)	13,8	3/8	2,6 / 5,8 x 2,8	20 / 1 x 7,62	280	65/600
YPR-765 (USA[1])	13,7	3/7	2,79 / 5,3 x 2,8	25 / 1 x 7,62	265	60/490
M2 Bradley (USA, 1981)	22,6	3/7	2,9 / 6,4 x 3,2	25[2] / 1 x 7,62	500	66/480
MCV-80 Warrior (UK, 1985)	24	3/7	2,7 / 6,3 x 3	30 / 1 x 7,62	550	75/500
VCC-80 (Italy, experimental)	19	3/6	2,6 / 6,7 x 2,9	25 / 2 x 7,62	480	70/600
KIFV (South Korea, 1984)	12,9	3/7	2,5 / 6,79 x 3,28	— / 1 x 12,7 H, 1 x 7,62	280	74/480
VCTR (Argentina-FRG, 1979)	27,5	2/10	2,45 / 6,79 x 3,28	20 / 2 x 7,62	720	75/570
Tornado (Switzerland, experimental)	22,3	3/7	2,9 / 6,7 x 3,15	25 / 2 x 7,62	390	66/400

1. This IFV was adopted by the Dutch Army in 1977, the Belgian Army in 1979, and the Philippine Army
2. There is also a TOW ATGM launcher (unit of fire is seven missiles)

tracked APCs led to the appearance of a questionable hybrid which has to fulfill both a transport and combat role. In fact, however, the vehicle proved to be not too adapted for either role and the opinion is widespread in the West at the present time about the need to have heavily armored infantry transport equipment and to have separate vehicles for various weapon systems.

Many foreign specialists now emphasize the need to develop an IFV with the very same level of protection as a tank. Proposals appeared in the western press in the latter half of the 1970's about the advisability of creating IFV's based on tanks. In connection with tests of the American M2 Bradley in 1981 the British journal RUSI wrote: "How will the M2 IFV be able to transport infantry near the forward edge if it is vulnerable to practically all kinds of direct-fire weapons? If an attack vehicle is required for an entire infantry squad, should it not really have the very same level of protection as provided for the four persons of a tank crew?"

Sharp criticism of the M2 Bradley IFV has even intensified of late. For example, representatives of the U.S. Congressional Budget Office emphasize that the principal shortcomings of this vehicle (covered up at one time by the Department of the Army) are weak armor protection, low survivability, insufficiently effective armament and too broad a range of assigned combat missions.

In the opinion of some foreign specialists, a logical alternative to insufficiently protected light IFV's is considered to be heavy IFV's which should be created using the hulls and main assemblies of tanks. In this case more powerful armor protection can be obtained (including by rejecting the heavy turret) and the vehicle will be capable of operating under enemy fire together with tanks. Such IFV's will not be amphibious but will be able to cross water obstacles using appropriate crossing equipment.

Western specialists emphasize that a choice has to be made in creating the vehicles: either the heavy IFV is a permanent means of transportation in which the infantryman has his place, or it is a special vehicle into which he "is squeezed to participate in an assault." Adherents of the heavy IFV note that up until now its design usually is linked with higher cost, but an assessment of such a vehicle should be approached above all from the standpoint of the possibility of more complete accomplishment of primary missions on the battlefield inasmuch as

in practice the M2 Bradley IFV's apparently will be incapable of performing them. Meanwhile it is quite obvious that heavy armor will make neither the tank nor the IFV invulnerable to enemy fire; on the other hand, it will increase the chances of each in withstanding such fire and will strengthen the entire combat formation. It also has to be considered that in this case a common power plant, transmission and running gear will be used for the two vehicles of the heavy family and so driver-mechanics and maintenance and repair specialists will undergo an identical training course. At the same time the operating cost and the fuel consumption of heavy vehicles will be higher, they will damage the road more heavily and they will be less adapted for autonomous operations and for air movements. But all this is less important in the opinion of a number of foreign specialists, since the powerful protection of the heavy IFV's will permit them to successfully accomplish the primary mission—ensure close interworking of infantry with tanks.

In the late 1970's the United States was considering the question of the expediency of developing an IFV on the chassis of the M1 Abrams tank which was to have a level of protection close to that of the tank, but the proposed project was not realized. Israeli specialists nurtured the idea of obtaining heavy IFV's by converting a certain portion of obsolete Centurion tanks to the given variant. Meanwhile, judging from foreign press reports, many western specialists still do not share the view of the advisability of developing heavy IFV's. This is indicated in part by continuing work in a number of capitalist countries to design IFV's in a traditional version, although naturally the appearance of heavy IFV's having a high level of protection above all also is not precluded.

6904

American Helicopter Reconnaissance and Target Designation System

18010332g Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 36-38

[Article by Col V. Dmitriyev]

[Text] The U.S. Army command gives considerable attention to improving the tactical capabilities of army aviation, including by improving means of supporting its operations at night and under conditions of poor visibility. For example, the AH-64A Apache attack helicopter which became operational was outfitted for the first time with the TADS (Target Acquisition and Designation System), permitting it to operate under nighttime conditions.

At the same time, considering the growing capabilities of enemy ground forces' air defense weapons, American specialists continued to seek ways to ensure concealment and promptness in reconnaissance conducted by Army helicopters with a simultaneous increase in their survivability. As noted in the foreign press, ground surveillance radars are capable of detecting a hovering helicopter at distances up to 15 km in any weather conditions. Based on this, American military experts believe that even the AH-64A Apache can be easily detected and destroyed by unit air defense weapons inasmuch as the TADS is accommodated in the fuselage nose, which does not permit it to operate from behind cover, especially in conducting reconnaissance and firing ATGM's against armored targets. Therefore further development also was aimed at a more rational accommodation of a future surveillance and target designation system.

In the early 1980's the American firm of McDonnell Douglas created the MMS (Mast Mounted Sight) system installed on the OH-58D helicopter (Fig. 1 [figure not reproduced]), which is a modernized version of the OH-58A Kiowa reconnaissance helicopter. In contrast to the TADS, input devices of this system are accommodated above the main rotor hub, permitting the crew to use natural and artificial cover (hills, structures, crowns of tall trees and so on) while conducting reconnaissance. Maximum reconnaissance range is 6 km. American specialists assess it as quite sufficient, especially for the European theater of war, inasmuch as it is believed that the practical range for acquisition of ground targets from treetop height is not over 3 km.

Meanwhile that design solution entailed a need to create a special stabilized platform for accommodating the reconnaissance-sighting gear. According to foreign press reports, the platform of the MMS system provides for this gear's normal operation under conditions of heavy vibrations created both by main rotor rotation and by firing on-board weapons, as well as during the helicopter's random pitching and rolling under the effect of wind when it is in a hover mode.

The stabilized platform, which has yaw and pitch angle stabilization channel gyroscopes, an automatic collimator and electromagnetic drives, is suspended on a special spherical bearing with a low coefficient of friction, flexibly mounted on four damping springs on the frame of an azimuthal gimbal joint. The springs effectively damp vibrations transmitted through the main rotor hub as it rotates. The optical autocollimator with mirrors permits identifying any angular deviations of the stabilized platform in the three-dimensional rectangular grid system given by the gyroscopes, and producing error signals causing electromagnetic drives to work to reduce angular deviations to zero. These drives essentially are electric torque motors which use stators rigidly connected with the stabilized platform and armatures fastened on the frame of the elevation gimbal joint. The stators are made with electromagnets from rare earth elements which with their compact design create a rather

powerful magnetic field for controlling the position of the armatures. Tests of the platform conducted for 3,000 hours showed that this system provides for line of sight stabilization approximately ten times better than existing methods.

The stabilized platform's gimbal joints permit rotation relative to the helicopter's longitudinal axis within limits of plus or minus 190 degrees in azimuth and plus or minus 30 degrees in elevation.

The reconnaissance-sighting gear (Fig. 2) is accommodated on the platform beneath a spherical fairing (diameter of 650 mm) made of composite material. The gear consists of a television camera, forward-looking infrared (thermal vision) set and laser rangefinder-target designator. The rest of the gear (computer unit and power unit) is installed within the helicopter and connected with the main gear through a multiple-conductor cable running along the inner channel of the main rotor shaft post. Lines of sight of the reconnaissance-sighting gear are at a height of around 0.9 m above the tip-path plane. Overall weight of the MMS system is 105 kg.

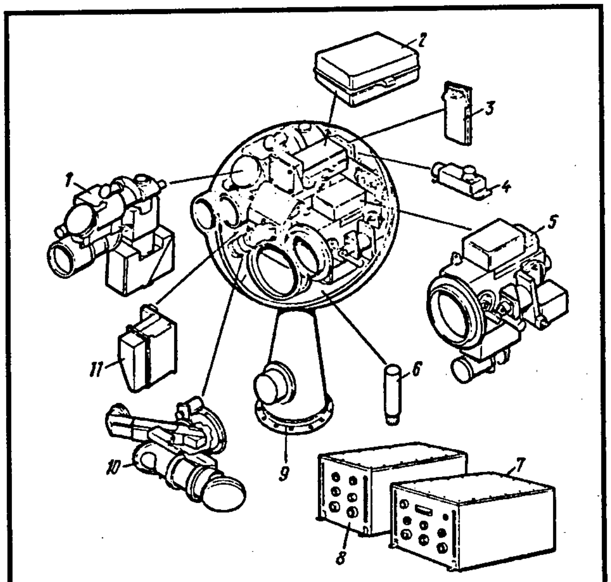


Fig. 2. Elements of MMS reconnaissance and target designation system:

Key:
1. Television camera
2. Laser rangefinder-target designator unit
3. Electronic unit supporting gyroscope operation
4. Gyroscope unit
5. Forward-looking infrared set
6. Dehumidifier
7. Computer unit
8. Power unit
9. Support
10. Optical axes interface mechanism
11. Electronic processing and multiplexing unit

The television camera is made with a vidicon with silicon target providing for operation at very low levels of external illumination (thanks to a sensitivity spectrum in the near infrared range). The input aperture diameter is 10 cm. The camera has two angles of view: 8 degrees, used in target search; and 2 degrees, serving for target identification.

The forward-looking infrared set with mosaic detector of 120 light-sensitive elements supporting reconnaissance at night and under conditions of reduced visibility also has two angles of view: 10 and 3 degrees.

The laser rangefinder-target designator serves both for measuring range to target and for illuminating the target when using laser semiactive guidance systems such as the Hellfire ATGM or the M712 Copperhead artillery projectile.

The common optical objective lens of the television camera and laser rangefinder-target designator dictates the identical orientation of their line of sight. At the same time, the IR set's line of sight is displaced relative to that of the rangefinder-target designator, requiring their interface for joint tactical employment. This is done automatically (in less than 30 seconds) by an interface mechanism which by rotating closes the television camera aperture and deflects the rangefinder-target designator laser beam into the IR set's field of view, where the set's line of sight is adjusted on the laser's light spot.

The MMS system computer unit has a digital sweep converter which reproduces and stabilizes images received by the television camera and IR set on the display screens. The computer unit also permits automatic tracking of a selected target, including with the target's temporary disappearance behind cover.

System controls are concentrated almost completely on the pilot-operator's control column, which in ordinary flight is used to control main rotor cyclic pitch. In particular they permit selecting the television camera or IR set for tactical use, changing the angles of their field of view, freezing the image being received, and switching on the automatic target tracking mode and laser rangefinder-target designator when employing weapons.

The visual display of images and other data obtained with the help of the reconnaissance-sighting system is reproduced on two multifunction indicators (cathode ray tubes) aboard the OH-58D helicopter. For example, an image from the television camera or IR set, the laser rangefinder-target designator code, target information, flying-navigation data needed for weapon employment, and weapon readiness status are transmitted to the pilot-operator's display being used as a sight.

The MMS system also provides the capability of automatic transmission of target designation data (geographic coordinates of targets in the form of eight-digit

codes) to a ground command post, to army aviationattack helicopters or aircraft, and to artillery firing positions. It takes no more than 6 seconds to transmit one pulse over a secure radio channel.

The OH-58D helicopter is equipped with a navigation system with memory unit to which coordinates of up to 20 reference points or fixed targets can be input for automatic search and for orienting the reconnaissance-sighting system gear on selected targets.

According to basic characteristics (effective range and resolution), the new MMS reconnaissance and target designation system is comparable with the TADS of the AH-64A Apache attack helicopter. Troop tests have shown its high precision and reliability, while tactical-technical requirements for acquisition and tracking of moving ground targets were exceeded. In the assessment of American specialists, survivability of a helicopter with reconnaissance-sighting gear accommodated above the main rotor is approximately 50 percent higher than for a helicopter equipped with a similar system in the fuselage nose.

Modification of OH-58A Kiowa reconnaissance helicopters to the OH-58D version with installation of the MMS system is being done by the American firm of Bell Helicopter Textron. An improved engine and new rotors have been used on the modernized model. The foreign press notes that use of a four-bladed main rotor instead of a two-bladed rotor permitted reducing vibrations arising from its rotation. The new tail rotor has an improved design giving the helicopter hover mode stability with a wind velocity of up to 65 km/hr from any direction.

Built-in monitors are provided for the MMS reconnaissance and target designation system and for other onboard helicopter equipment; in particular this permits automating the system's preflight check and preparation, with results displayed on multifuntion indicator screens. Replacement of any unit of the gear located beneath the fairing takes up to 15 minutes, and replacement of the entire apparatus up to 30 minutes. The system's calculated mean time between failures is 140 hours.

In the future it is planned to arm OH-58D helicopters with air-to-air missiles being created on the basis of the Stinger surface to air missile.

The first lot of MMS-equipped OH-58D reconnaissance helicopters already has been delivered to U.S. Army aviation. Earlier it was planned to purchase 578 such machines, but this figure now has dropped to 138. All OH-58D helicopters will be used only in the interests of field artillery (observation, reconnaissance and laser beam target illumination). Prior to this it was planned to use them together with AH-64A Apache attack helicopters. One set of the MMS system was delivered to Great Britain for evaluation tests in the Lynx-3 helicopter within the framework of a British program for creating a light fire support helicopter.

6904

Winning Air Superiority (Foreign Specialists' Views)

18010332h Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 39-44

[Article by Col A. Krasnov, doctor of military sciences, professor]

[Text] In the opinion of the armed forces command of the United States and other NATO bloc member countries, winning and maintaining air supremacy (in the terminology of bloc military experts, superiority) always has been and always will be a necessary condition for successful combat actions despite the fact that there are considerable difficulties involved in attaining it. The basic method for accomplishing that mission is considered to be destruction of the opposing side's aircraft at airfields and in the air.

A broad discussion about this is going on in the pages of the western press. Major military leaders and specialists are engaging in polemics, and works of military scientific institutes are being published, which emphasize the problem's extraordinary complexity and contradictoriness. Almost all military experts turn to past experience in assessing the influence of various factors on methods of the struggle to win air superiority and on the choice of the most advisable of these methods.

The foreign press notes that the struggle for air superiority was waged at all fronts and in all theaters of World War II, but the proportion of methods of the struggle was not the same. The basis of German air actions in the first operations consisted of surprise mass strikes against airfields of countries which were the targets of aggression. Aircraft were usually bunched up and did not have time to take off from them [their airfields] to evade the strikes. Japanese aviation operated in a similar manner in unleashing war against the United States and Great Britain in the Pacific basin. Air combat came to the fore later in the course of the war when the opposing sides' aviation was in a higher state of combat readiness. By admission of American military historians, fighter air commands of the U.S. and British air forces always tried to ensure a numerical superiority over the enemy. Their aircraft performed air alert in large groups of 30-40 aircraft and waited a long while for a favorable moment to begin combat. Such "cautious" tactics naturally did not contribute to high air combat results.

Subsequently the absence of a direct threat to vital U.S. and British targets again led to an increase in the role of airfield strikes. The foreign press reported that the primary targets of Anglo-American strategic and tactical aviation were Luftwaffe airfields as well as aircraft plants, oil refineries and other industrial enterprises supporting the German Luftwaffe's combat effectiveness.

The nuclear era which followed soon after the end of the war radically changed views on methods of winning air superiority. With nuclear missile weapons it became possible to deliver strikes of enormous devastating force against the most remote airfields in a matter of minutes and inflict such losses on aviation which could lead to an immediate and abrupt change in correlation of the sides' forces. In connection with this many foreign specialists believed that the struggle for air superiority can be waged without active participation of fighter aviation. At that time the concept for the combat employment of the American Air Force primarily envisaged strikes against airfields and destruction of aircraft as well as of nuclear weapon depots there. Fighter aviation employment was thought of in a limited manner and only for engaging the aircraft which survived nuclear strikes against airfields in air combat.

Such views existed for a rather long while and were given a practical check during numerous local wars waged with the use only of conventional weapons. How the place and content of methods of struggle for air superiority changed and improved from war to war can be traced in rather great detail in the western press.

In the aggressive wars which the United States unleashed in Korea and Vietnam the American command rested great hopes on destroying enemy aviation at airfields. It succeeded in destroying the majority of airfields located on DPRK territory, but the objective was not achieved since Korean fighters were rebased to China and continued active combat. Results of operations against DRV airfields also proved poor because of good camouflage and dispersed aircraft basing. This occurred despite the fact that with a numerical superiority in aircraft the U.S. Air Force command did not reckon with the principle of economic expenditure of forces; this is inadmissible in a large-scale war, in the opinion of NATO military experts. For these reasons active and stubborn air combat became the primary method of struggle for air superiority.

While it was conducted with large forces in Korea, however, in Vietnam there was no massing of efforts and commitment of large groups of fighters on decisive axes because of the small numbers of fighter aviation opposing the aggressor. Tactics of the Vietnamese pilots were based on swift surprise attacks against the most vulnerable American aircraft. The Swiss journal INTERAVIA pointed out that surprise attacks with small forces were the principal factor ensuring effectiveness of tactical employment of DRV fighters. Surface-to-air missile [SAM] systems played a major role in the national air defense system along with the fighters.

The struggle for air superiority followed a different path in the Arab-Israeli wars. In 1967 the Israeli Air Force succeeded in inflicting a heavy loss on Arab aviation at the very beginning of the war by delivering airfield strikes. Based on this many foreign theorists concluded that such strikes were decisive. However, this sad experience entailed other consequences previously not predicted. Sturdy, reinforced concrete aircraft shelters appeared at airfields in many countries and powerful SAM cover of aircraft locations began to be organized. Survivability of aircraft on the ground rose substantially as a result. For example, the Israeli Air Force did not succeed in destroying a large number of aircraft of Arab countries on the ground in the 1973 war. This occurred because the airfields were heavily defended by SAM systems and the aircraft were in sturdy shelters. Israeli aircraft which attacked them suffered considerable losses.

The center of gravity of the struggle for air superiority again shifted to air combat. In comparison with past wars, it was characterized by extensive use of feints and demonstration measures, by more dispersed combat formations, and by reinforced tactical coordination between fighter subunits.

Fighter aviation tactics saw further development in the war in Lebanon (1982), when the Israeli Air Force was augmented by more sophisticated American-made F-15 and F-16 aircraft. Fighter control began to be exercised from airborne command posts consisting of E-2C early warning and control aircraft (Fig. 1 [figure not reproduced]). The latter issued target designation data, retargeted and built up fighter efforts in air combat, and helped pilots restore combat formations during combat. Electronic warfare aircraft also operated in the fighters' interests.

After thoroughly studying the course of air combat in local wars and comparing its results with airfield strikes, however, some western specialists concluded that under present-day conditions aviation still remained most vulnerable on the ground. This is explained by the fact that the power of attack forces with new precision weapon systems increased sharply, while modern aircraft are on the limited area of airfields and cannot get by without long runways with firm artificial surfaces. Such runways are very noticeable from the air and their restoration times after receiving strikes are rather high. U.S. Air Force Chief of Staff Gen C. Gabriel asserted with regard to this question that only by putting enemy airfields out of action would it be possible to reduce the number of enemy aircraft-sorties and keep this indicator at a rather low level.

In the opinion of other bloc specialists, it is becoming more and more difficult to catch enemy aircraft at airfields located in the interior of enemy territory. They emphasize that increased combat readiness of air units and subunits on the one hand and increased range of acquisition of the air enemy on the other hand (especially with early warning and control aircraft included in the air defense system) led to a situation where the time it took main aviation forces to lift off from airfields became commensurable with and even less than the flight time to targets by the attacking side's attack groups after their detection. In other words, under certain conditions enemy aircraft can take off from their airfields and evade a strike before it takes place. It is also noted that it is becoming more difficult to inflict losses on aircraft on the ground inasmuch as they are in rather reliable shelters as a rule and the effectiveness of air defense as a whole, especially the SAM cover of airfields, has increased greatly. It is becoming more and more difficult to penetrate such a screen. Moreover, not only aircraft but also enemy flight personnel are destroyed in air combat and the enemy's will to resist is demoralized. This is why fighter aviation has to wage stubborn air combat constantly both over friendly and over enemy territory, otherwise it will not ensure the winning and holding of air superiority and thus will not create favorable conditions for friendly aviation and ground forces to accomplish their assigned missions successfully.

And finally the foreign press notes that it is also necessary to consider the fact that in case permanent airfields with concrete runways are put out of action the bulk of enemy combat aircraft can be based at temporary dirt airfields. The flight personnel need no special training for this.

It follows from what has been said that different opinions exist, each with its pros and cons. The question of just how the struggle for air superiority must be organized in order for it to bring maximum success remains open; the last word has not yet been spoken in this argument.

Referring to the contradictoriness of the problem, the majority of prominent NATO military leaders believe that it is impossible to require an unequivocal approach to its solution. Too many factors influence the choice of method of the struggle for air superiority. This includes basing, composition, and capabilities of aviation to achieve surprise and evade an attack, the correlation of opposing forces, and much more. Therefore, in their opinion the proportion of airfield strikes and of air combat can change within rather broad limits under different conditions and at different periods of combat actions. They believe that the interrelationship and interdependence of these methods are intensifying under present-day conditions. For example, strikes against airfields and against air and air defense command posts create favorable conditions for fighter actions over enemy territory and for achieving a superiority in forces; successful air combat has a direct influence on results of airfield strikes inasmuch as strike aviation is given the opportunity of operating under conditions of weakened enemy opposition.

Western military experts declare, however, that in any case choice of the advisable method of struggle for air supremacy is determined to a considerale extent by the status of the opposing side's air defense. The problem of aviation penetrating enemy air defense is considered unresolved up until now. The journal INTERNATIONAL DEFENSE REVIEW points out that one part of the problem is the search for ways of overflying overlapping coverage of an enormous number of precision SAM systems, and another part is how to penetrate a screen of powerful fighter aviation armed with long-range air-to-air missiles and capable of operating day or night in all weather conditions. Therefore even a large numerical superiority in aircraft on the part of either side will not permit it to completely accomplish a single combat mission if the opposing side's air defense system is not neutralized. It is emphasized that this was not the situation in the past, when the destruction of ground air defense weapons was of a secondary or even incidental nature for aviation, but this was because there was not such a powerful defense system.

In the opinion of foreign military specialists, with strong air defense preference should be given to destroying enemy aircraft in the air, while delivering airfield strikes makes sense only with his insufficiently developed air defense system or in case of acute necessity. The latter case, however, will require a large expenditure of forces.

Electronic warfare [EW] is becoming an integral component of the struggle for air superiority. In recent years NATO and other capitalist countries have been giving very great attention to problems of conducting EW. At the present time EW questions occupy one of the decisive places in all manuals and regulations concerning tactical employment of all branches of the armed forces including aviation.

After analyzing the experience of local wars and numerous exercises and maneuvers, western military experts state that in the course of winning air superiority and in accomplishing other missions intensive jamming of ground radars, on-board sights of fighters, and VHF communications equipment can completely disrupt command and control of enemy air defense forces and resources before strikes are delivered against him. In particular they believe that the use even of simple radar reflectors will seriously hinder the discrimination of blips from airborne targets on radar screens of SAM resources, and ordinary noise jamming can lead to disruption of communications among enemy aircraft and to confusion in their combat formations as well as to increased difficulty of their control from ground command posts.

Based on this, in addition to maneuver and fire the content of air combat now also has to include actions for electronic suppression of appropriate enemy on-board and ground equipment. To this end active jammers, automatic chaff and IR decoy dispensers, and other equipment (including for protecting friendly electronics against jamming) are being installed in fighters of air forces of NATO countries and other states. In addition, modern fighters must be armed with air-to-air antiradar missiles similar in operating principle to missiles intended for destroying ground radars.

Consequently, in the opinion of NATO specialists, air superiority can be won only with comprehensive application of both methods. Two specific missions have to be accomplished to successfully achieve this: destroy the opposing side's air defense and conduct EW continuously. These provisions extend to winning air superiority not only on a strategic and operational scale, but also in small areas and for a brief time.

In accordance with these views all major NATO exercises practice the destruction of enemy aircraft both at airfields and in the air. Judging from exercise experience, however, this does not preclude the possibility of the predominance of airfield strikes as well as the predominance of air combat depending on the situation.

In delivering airfield strikes the attacking side's main efforts are aimed not at destroying aircraft in shelters, which requires a large expenditure of forces, but on putting runways, taxiways, control entities, POL depots and other important facilities out of action. It is planned to replace high explosive and concrete-piercing bombs used for airfield strikes with precision weapons—guided aerial bombs and missiles. Specialists give special attention to the development of cluster weapons for attack aircraft and cruise missiles which can be used for engaging various ground area targets including airfields. For example, the FRG created the MW-1 suspended bomb cluster and Great Britain created the JP-233 (Fig. 2 [figure not reproduced]). Before being suspended on an aircraft readying for a raid on an enemy airfield, such a cluster is to be filled chiefly with concrete-piercing aerial bombs and mines with different methods of detonation and different delay times. According to calculations of western experts, the use of cluster weapons will allow not only inflicting serious damage on targets, but also mining them. The latter will prevent movement on the airfield and conduct of restoration work. In the opinion of NATO military experts, the new weapons will make it possible to engage runways and small targets on airfields in a more concealed, sudden and swift manner and will shorten the time for delivering attacks.

When the opposing side has strong air defense which is impossible to neutralize and high-strength aircraft shelters, decisive importance is attached to destroying aviation in group air combat and battles with the participation of considerable fighter aviation forces. Therefore, during a further build-up of NATO Armed Forces in Europe a considerable number of fighters especially adapted for air combat such as the F-15 Eagle (Fig. 3 [figure not reproduced]), F-16 Fighting Falcon, Mirage-2000C (see color insert [color insert not reproduced]) and Tornado-F.3 are being delivered to bloc Allied Air Forces along with attack aircraft. Long-, medium- and short-range air-to-air guided missiles are considered their basic weapons.

The foreign press notes that lately in addition to the struggle against enemy combat aviation the NATO military leadership has included missions of destroying airborne command posts, early warning and control aircraft, cruise missiles, drones and other flying craft in the concept of "winning air superiority." It is emphasized that each of them represents an airborn target with unique features. Tactics of their combat employment also differ.

For example, cruise missiles and drones have small size and small radar cross section and they make the flight to targets primarily at extremely low altitudes to conceal it. Conversely, early warning and control aircraft as well as airborne command posts considerably exceed them in size and fly at high altitude along closed routes in zones located in the depth of friendly territory at the limit of enemy fighter range and under cover of their own air defense weapons. Fighters must employ different tactical procedures in combat to destroy airborne targets varying in type and nature of actions. Therefore at the present time foreign theorists categorize the engagement of such targets as independent missions of fighter aviation.

Thus in the opinion of western military specialists the role and place of airfield strikes and air combat in winning and holding air superiority are dictated by the specific situation and cannot be determined unambiguously for all conditions of armed struggle. Air superiority, however, always will be a necessary condition for successful combat operations.

6904

Norwegian Air Defense System Modernization

18010332i Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 44-45

[Article by Col P. Apagoshin]

[Text] At a regular session of the "Oslo Military Society" in the capital of Norway, Norwegian Air Force Chief Inspector (CIC) Maj Gen Olaf F. Omut reviewed the status of the national air defense system. As is customary in the West, part of his speech was devoted to intimidating the audience with the so-called "Soviet military

threat." In particular he declared that "all Norwegian territory from the very north to the very south is situated in the zone of effective actions of the offensive Soviet Air Forces."

Referring to the weakness of the Norwegian Air Force's air grouping (the order of battle has only 69 modern F-16 tactical fighters), Omut emphasized the need for strengthening it at the expense of partners in the NATO bloc in a period of so-called "crisis situations." This already had been tested during numerous peacetime military exercises, and a network of infrastructure facilities was built in support of the operational use and engineering-technical servicing of aviation equipment of "overseas guests." In this regard Omut noted the importance of creating a reliable air defense system for air bases and other installations and areas earmarked for receiving and deploying allied forces.

As the foreign press reports, in addition to fighter aviation the Norwegian air defense system presently has the following: a Nike-Hercules SAM battalion deployed near the city of Oslo consisting of four batteries, each with nine launchers (the battalion headquarters is located in Linnerude), and a considerable number of light AAA batteries.

The latter are employed for covering main airfields against low-flying enemy aircraft. In particular, three light AAA batteries each are deployed near Bodo, Andoya and Bardufoss air bases and four batteries each at the Rygge, Lista, Vaernes, Sola, Gardermoen and Orland airfields.

The light AAA battery includes four weapon platoons and a headquarters platoon. Its inventory includes considerably outdated L-70 or L-60 40-mm antiaircraft guns (the Norwegian Air Force has a total of some 100 of them) and two 12.7-mm machineguns (several batteries have more modern 20-mm antiaircraft mounts). The headquarters platoons are outfitted with acquisition and target designation radars as well as with necessary means of communication with weapon subunits.

As pointed out earlier, however, in the opinion of the country's armed forces command, the above personnel and equipment allegedly are insufficient for performing missions assigned by the NATO military leadership. Measures for modernizing the Norwegian air defense system have been developed and are being implemented to solve this problem.

In particular, at the aforementioned "forum" Maj Gen Omut announced that in accordance with a special agreement with the United States the Norwegian Air Force ordered six batteries of the NOAH (Norwegian-adapted Hawk) SAM system for defending the most vital air bases, chiefly in Northern Norway. This system is a version of the Hawk SAM system adapted for local conditions. It was created jointly by American and Norwegian research and industrial organizations.

In addition to the SAM launchers the system includes a three-dimensional target acquisition radar (a joint development of American and Norwegian firms) and a new fire control system from the Norwegian firm of Kongsberg Vapenfabrikk. According to estimates of the creators, the latter should provide for tracking several tens of targets and for output of target designation data on them. It is also planned that the SAM system will include a thermal imaging system for acquisition of airborne targets to ensure stable operation of the system in case its radar control and guidance equipment is heavily jammed. The system's tactical-technical characteristics differ significantly from the Improved Hawk SAM system in the inventory of the United States and many other NATO countries.

Organizationally the SAM system battery includes three weapon platoons of three launchers each (three missiles on one launcher). Thus 27 missiles are simultaneously ready for launch in a battery. In addition, the battery has a headquarters platoon which acquires the airborne enemy and guides missiles to it.

According to the foreign press two such batteries were delivered to the Norwegian Air Force. One is stationed in the combat training center (Stavern, Southern Norway) and the other at Andoya Air Base (Northern Norway, Vesteralen Islands, in the immediate vicinity of the missile test range). The system's delivery tests are conducted here. Real launches of missiles (without warheads) against airborne targets already have been accomplished. The Norwegian Air Force planned to complete the program of testing the NOAH SAM system by the end of 1987. The other four batteries should be delivered by this same time. Subsequently all six batteries are to be deployed at Bodo, Andoya, Bardufoss, Evenes, Orland and Vaernes air bases, where construction has been completed on primary and auxiliary structures to accommodate them.

The air defense system in Southern Norway differs substantially from that being created in the north. The Nike-Hercules SAM battalion is the basis of its active forces. Its combat mission is defense of the capital and adjoining installations including Fornebu International Airport and air bases of Gardermoen and Rygge.

Recently the country's government adopted a plan for phased modernization of that battalion. It is planned to remove the 1st Battery from alert duty in early 1988 and the 2d Battery a year later. The Nike-Hercules SAM system will be in the inventory of the other two batteries for several more years, and only in the first half of the 1990's will they possibly be replaced by new systems. This is justified by the fact that by this time, according to calculations of Norwegian Air Force specialists, operation of the Nike-Hercules SAM system will become unprofitable from an economic standpoint (considering the cost of deliveries of spare parts, auxiliary equipment and so on).

For those same reasons it is also considered unpromising to use certain other weapon systems in Southern Norway, including the latest American Patriot SAM system. Reliance is being placed on "inexpensive" SAM systems, particularly on a new one developed on the basis of the Hawk system or on SAMRAAM, designed by the American firms of Raytheon and Hughes for organization of installation air defense. The adoption of one of them (the preferable version presently is being evaluated by Norwegian specialists) will cost the country's taxpayers 415-830 million Norwegian krone (100-200 million pounds sterling at the June 1987 exchange rate), but authorities are hoping that Norway's military-industrial firms also will take a significant part in producing the SAM systems being purchased.

In the opinion of the Air Force Chief Inspector, the Southern Norway air defense system should represent a combination of fighter-interceptor squadrons of NATO bloc member countries moved here in "crisis situations," and Norwegian SAM and light AAA batteries.

It is planned to deploy the Hawk or SAMRAAM SAM systems only at two of the seven most important air bases in Southern Norway (Gardermoen and Rygge). Only AAA batteries will remain at the other five—at the capital airport and at Kevik, Lista, Sola (Stavanger) and Fleslann (Bergen) air bases.

In the process of developing the air defense system it is planned to outfit light AAA batteries with new acquisition and target designation radars and equip AA guns with radar and infrared sights. In addition, work is under way to create more improved ammunition to increase their fire effectiveness.

In addition to this, the latest automated radar stations are being deployed on the territory of Norway in accordance with plans of the NATO military leadership.

In the opinion of foreign experts, all those measures will considerably strengthen the air defense system of the NATO bloc's northern flank.

6904

Use of Composite Materials in Aircraft Construction

18010332j Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 46-52

[Article by Professor V. Filippov]

[Text] Under conditions of a constant build-up in the arms race aggressive circles of the West are trying to use all opportunities to create weapon systems based on the latest technology. Special attention is being given to improving aviation equipment and increasing its effectiveness and reliability.

A qualitative leap was made in recent years in the course of a struggle to reduce the structural weight and cost of aircraft in connection with the appearance of new structural materials which have been given the name "composite." Composite materials are various plastics or light metals reinforced by fibers of carbon, boron or synthetic substances. They have high strength and rigidity, which along with acceptable viscosity and density permits them to compete positively with traditional metals in the construction of combat aircraft.

A rather complete review of prospects for use of composite materials abroad was published in the pages of our journal in 1984,[1] but recently a series of new information has appeared about foreign firms' development American firm of Grumman studied possibilities of creating a future fighter with unlimited use of composite materials under the ADCA (Advanced Design Composite Aircraft) project. The objective of the work was to study the likely cost reduction of a supersonic fighter and concomitant weight reduction with maximum possible use of composite materials in its construction.

Requirements placed on the ADCA aircraft were to ensure supersonic cruising speed, high acceleration characteristics and rate of climb, lengthy combat maneuvering at altitude at Mach 0.9, and good airfield performance. Graphite-epoxy, boron-epoxy and graphite-boron-epoxy materials, which were sufficiently worked out and already used previously in individual components of some aircraft constructions, were considered as possible composite materials for use.

The project of an aircraft with a take-off weight of 17.33 tons was chosen from several versions of a future supersonic fighter satisfying the requirements laid down; it was the cheapest and lightest (Fig. 1). Its acceleration time from Mach 0.8 to Mach 1.6 at an altitude of 10,000 m was 79 seconds. The take-off run with missiles on external mounts with an overall weight of 5.54 tons did not exceed 975 m. The landing run also was the same distance. The most difficult to fulfill was the requirement to ensure lengthy combat maneuvering of the designed fighter with a g-load of 3.8 at an altitude of 9,000 m and a speed corresponding to Mach 0.9. Considering that the design temperature of the aircraft skin in the most important flight regimes did not exceed 127[] Centigrade, the decision was made to use graphite-epoxy as the primary structural material, from which the following basic structural components were designed: multispar continuous wing, foreplane (all-moving stabilizer), vertical tailplane (with honeycomb filler), semimonocoque fuselage with wing attachment to it on three load-bearing spars.

The foreign press notes that compared with a fighter of similar purpose and with similar technical flight characteristics but made of traditional metal alloys, wide use of composite materials substantially reduced the weight of basic structural components of the ADCA aircraft, including 28 percent in the wing, 22 percent in the

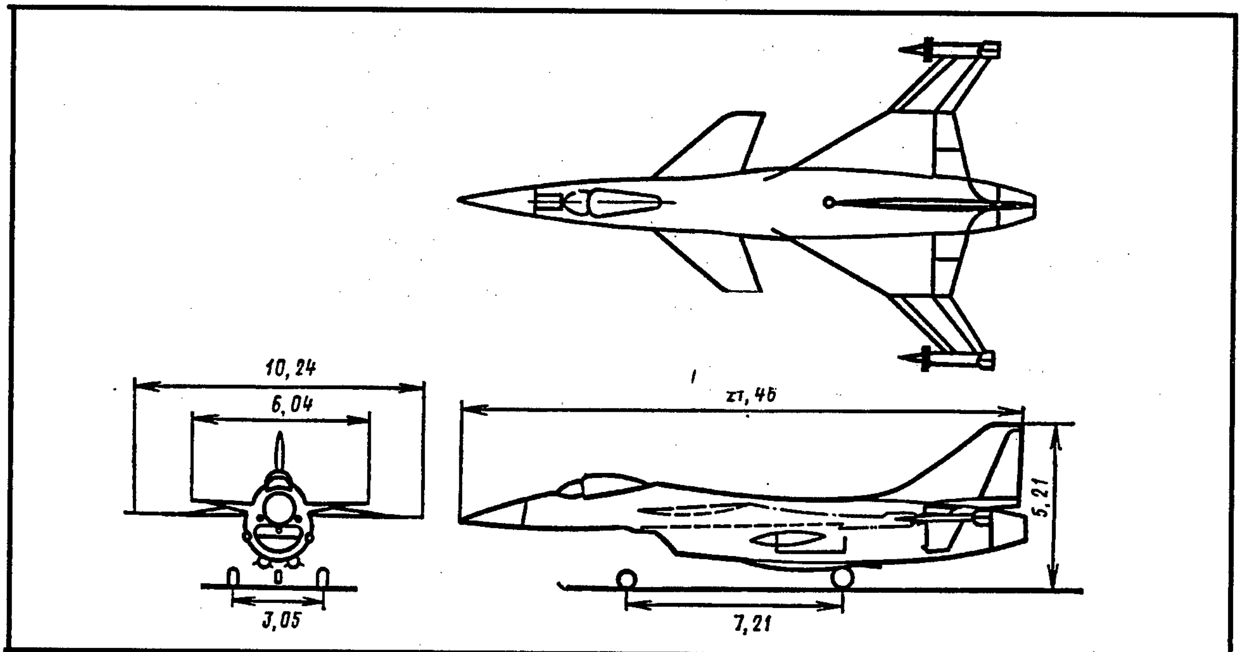


Fig. 1. Drawings of general views of fighter being created under the ADCA program (dimensions in meters)

fuselage, 23 percent in the foreplane and fin, and 20 percent in the power plant air intakes. Studies showed that a certain decrease in weight of the aircraft construction also can be achieved using the latest metal alloys, but in this case the proportion of weight reduction does not exceed 9 percent.

In addition, American specialists assert that they managed not only to design a stronger and lighter wing meeting given specifications, but also to give it new aeroelastic properties. In particular, in flight under the effect of aerodynamic forces the wing is capable of acquiring a specific twist at a certain angle close to optimum for the given flight regime without the help of controls. In this way the wing's lift/drag ratio is kept close to optimum in different flight regimes. Wings of metal construction do not have that capability. In wings made of composite materials, however, the effect of programmed aeroelasticity is achieved with consideration of a forecasting of the pairing of "flexural-torsional" strain by appropriately selecting the placement of composite material lamina of varying number and orientation along the wingspan.

Foreign specialists point out three possible methods for placing composite material lamina: rotation of longitudinal lamina, unbalance of transverse lamina and rotation of the entire placement scheme. It is believed that all of them provide the requisite nature of change in wing strain in flight, but the last two methods are not recommended for use since they simultaneously lead to a reduction in the wing's torsional rigidity and consequently to a decrease in the speed where flutter appears.

Calculations showed that placement of torsion box skin lamina with a 15 degree forward rotation of the lamina in the ADCA aircraft wing provides best values of wing twist and helps the aircraft achieve high maneuver characteristics. This thesis was confirmed by appropriate wind tunnel tests. A similar effect also can be achieved in a nontwisted wing, but with the help of deflection of special control surfaces, which requires an increase in aircraft weight due to the need for installing an additional system and controls.

The method of controlling structural rigidity by rotating the longitudinal composite material lamina in the process of placing them in the skin (in this case by 15 degrees backward with respect to the longitudinal axis) was used in creating the fin of the ADCA aircraft. Transverse composite material lamina (90 degrees) and crossed lamina (plus or minus 45 degrees) retained their position. As a result there was a 35 percent increase in the design flutter speed and 23 percent increase in fin strength for the most critical design case.

Meanwhile in the process of designing the ADCA aircraft Grumman experts proved that the simple substitution of composite materials for metal alloys in the construction may lead in the final account only to a slight decrease (around 13 percent) in its take-off weight, which is economically unjustified with consideration of the high cost of composite materials. But if the design of such an aircraft is created [sozdavatsya] in advance with consideration of features of composite materials and they are used purposefully, then its cost in the supersonic fighter version drops by 25 percent (in 1980 prices), the cost during its service life drops by 21 percent, and the take-off weight drops by 26 percent compared with a similar aircraft made of metal.

The western press reports that studies of features of creating various structural components of military aircraft based on composite materials have been conducted

for many years now at the Grumman firm. For example, by the early 1980's the stabilizer and landing gear doors of the deck-based F-14 Tomcat fighter, the wing torsion box and side panel of the F-111 fighter-bomber and a number of other components have been designed, built and tested. Boron-epoxy composite materials initially were the basic structural materials, and later there were cheaper graphite-epoxy composite materials.

Experience also was gained in building the large stabilizer unit for the strategic B-1 bomber using both graphite-epoxy and boron-epoxy composite materials. It was planned to compare it with a stabilizer made of metal alloys. A stabilizer of composite materials was supposed to demonstrate the desired strength, the structure's permissible fault rate, and a substantial reduction in the number of structural components and the number of openings for fastening parts, and it was supposed to eliminate costly metal alloys from the structure. Results of program fulfillment are assessed positively. The firm's specialists succeeded in creating a fully satisfactory structure which very successfully withstood the prescribed extent of special tests: longitudinal compressive strength in a temperature range from -20 to +127 degrees Centigrade, fatigue from high acoustic loads (a load up to 167 db for 181 hours), resistance to storm discharges (a current up to 200×10^3 A) and others.

Judging from foreign press reports, the stabilizer made of composite materials showed the following advantages in comparison with a similar one made of metal: reduction in the number of load-bearing parts from 270 to 108 and in the number of fastening elements from 26,700 to 14,300, a decrease in structural weight from 1.5 to 1.27 tons and a 17.5 percent decrease in cost of the entire article.

Based on the experience gained and given a probable improvement in the composite materials themselves, Grumman specialists express the supposition that by 1990-1992 even partial use of composite materials in aircraft construction will permit reducing the structural weight of military aircraft by 11-12 percent.

Similar results were obtained by Lockheed as a result of studies of a rudder (for the Gulfstream-IIID aircraft) and aileron (L-1011) constructed of composite materials. For example, the aileron, fabricated mainly from graphite-epoxy composite materials, was 22.6 percent lighter, 21 percent cheaper and demonstrated 50 percent better fatigue longevity in comparison with a metal aileron.

With respect to the use of composite materials in the construction of military helicopters, the firms of Bell and Sikorsky in the United States are continuing work under the ACAP (Advanced Composite Airframe Program). According to foreign press reports, a helicopter fuselage was made from composite materials by the autoclave forming method from prepregs (lamina) in the form of a unidirectional tape and fabric, and a tail boom was made using the composite material winding method.

This technology of fabricating basic helicopter parts permitted obtaining a structure which has better characteristics of permissible fault rate (including as a result of direct holes), higher fatigue longevity, reliability and operating technological effectiveness in comparison with a metal structure. In the opinion of American specialists, with wide use of composite materials in the construction of military helicopters they will succeed in achieving a 17 percent cost reduction and a 22 percent reduction in structural weight.

Forecasts have appeared in the foreign press of late that by 1990 there may be a reduction of up to 35 percent in aircraft structural weight on condition of the use of composite materials with an improved epoxy matrix, and by the year 2000 a 40 percent weight reduction with the introduction of composite materials with a metal matrix. These forecasts are confirmed by foreign specialists' estimates based on a determination of the contemporary level of physico-chemical properties of composite materials (both of reinforcing elements and the matrix binder) and possible prospects for their improvement over the next 10-15 years. Table 1 provides basic indicators of the strength of certain contemporary reinforcing elements of composite materials compared with similar parameters for metals being used in aircraft structures.

Various polymers presently are being used abroad as a binder, because of which the composite materials acquire specific properties. For example, thermosetting resins and lately thermoplastic polymers and even metal alloys have found wide use in composite material matrices, giving them a number of advantages in some strength characteristics, operating technological effectiveness, and maintainability. Along with the chemical composition of the reinforcing fiber and matrix, the strength of composite materials is determined by the number and thickness of lamina in the tape or fabric and by their orientation of placement during the production process. The strength of composite materials also is affected by working conditions of the structure made from it when the aircraft is operated (temperature, humidity, ambient pressure and so on).

Judging from western press materials, despite the fact that design cases for evaluating strength and longevity of aircraft structures of composite materials are the very same as for similar devices made of metals (tension, compression, shear and twist, repeat loads and so on), the behavior of composite materials in loading, kind of deformations, and failures still have been insufficiently studied. The supposition is expressed that with consideration of a deeper understanding of the mechanics of receiving loads inherent only to composite materials, strength criteria specific for these materials must be developed. Given as an example is a comparison of the difference in taking account of a stress concentration in the zone of openings or cut-outs in panels made of metals and composite materials. While the notch-sensitivity index in metal panels, the material of which has greater

Characteristics	Aluminum Alloy	Steel	Titanium Alloy	Boron-Reinforced Plastic	Graphite-Reinforced Plastic	
					1	2
Tensile strength, MN/m^2	450	1230	926	1720	1030	1520
Relative density........	2.8	7.87	4.5	2.05	1.6	1.55
Specific tensile strength, MN/m^2.......	160	156	206	839	644	980
Modulus of elasticity, GN/m^2	69	200	110	241	207	131
Specific modulus of elasticity, GN/m^2.....	25	26	24	118	129	85

plasticity, is taken as equal to 3 in the zones indicated, the same index in the zone of a circular opening for unidirectional graphite-epoxy composite materials must be chosen two times larger (equal to 8) because of the material's greater rigidity.

It is assumed that this circumstance must be given attention without fail in designing different kinds of connections of assemblies and parts made of composite materials. With consideration of the high stress concentration in the zone of openings in composite materials, various kinds of bonded joints not requiring openings to be made are preferable. In case use of a bolt connection is inevitable, however, it is necessary to make all calculations, taking into account the stress concentration in the zone of bolt openings. Test results are given in which the strength of a bolted connection of composite material structures (steel bolts) was almost three times less than the strength of an all-steel connection. For example, a bolted connection of steel withstood a load of 927 MN/m^2 in tension, while a connection of composite materials of similar structure (graphite-epoxy composite materials with lamina placement 0/plus or minus 45 degrees in the ratio one-third:two-thirds) withstood only 325 MN/m^2.

The main reason for such a decrease in strength of a composite material structure is considered to be nonuniformity of properties inherent to it in the longitudinal and transverse direction. While in the longitudinal direction (along the reinforcing fibers) composite material withstands loads commensurable with the strength of steel, in the transverse direction it is many times less. This deficiency, specific for composite materials, is eliminated by placing its lamina (prepregs) in a common packet of material at different angles relative to the orientation of the reinforcing fiber. By varying the number of lamina and orientation of their placement in designing a composite material structure, one manages not only to equalize strength properties of the composite material but also obtain a structure with preset value of stresses in its load-bearing components depending on the loads arising in the aircraft's various flight regimes.

But specialists encountered a number of serious difficulties in practical realization of this property of composite materials. The principal difficulty was the need for careful maintenance of all parameters of the technological process of fabricating both the composite materials proper and aircraft structures based on them. It turned out that even slight production defects such as small delaminations, poor adhesion or porosity substantially decreased strength properties of the composite materials. For example, with porosity of graphite-epoxy composite materials not exceeding 3 percent, shear strength of the material falls from 120 to 60 MPa.

Considering these circumstances, foreign firms devote great attention to ensuring stability of the entire technological process of fabricating composite materials and to monitoring its parameters. Automation of the entire production both of different components of composite materials and of constructions being made on their basis is being introduced for these purposes. In addition, strict instrumental inspection has been established over the quality of fabricated parts, including ultrasonic (with a frequency of 5 MHz), x-ray, eddy-current, optical holography and even acoustic. Each of the aforementioned nondestructive kinds of inspection performs certain functions. For example, by using ultrasound we succeed in establishing zones of porosity (cavities) in material. X-ray inspection reliably indentifies foreign inclusions. Use of high-frequency eddy currents makes it possible to accurately determine the orientation of reinforcing fibers in the placement and their volumetric content. Methods of optical holography reliably fix zones of poor adhesion, delamination and other deficiencies. Random tests of composite materials also are conducted in a humid environment and at higher temperatures.

At the same time the western press emphasizes that taking these steps to improve the technology and reinforce inspection of composite materials still does not guarantee proper stabilization of their physico-chemical indicators in production. Therefore it is necessary to take additional steps to prevent failure and ensure

proper flight safety. These include, for example, introduction of an increased safety factor to the design value of the load in designing. While one usually is limited to introducing a safety factor of 1.5 for aircraft structures made of metal alloys, this value is insufficient for structures made of composite materials. As foreign sources note, there is not yet a unified approach to assessing the magnitude of this factor. The United States is introducing various safety factors for different structures made of composite materials: 1.8 for suspended tanks, 2.25 for antenna fairings and so on.

Another serious deficiency of composite material structures is their low permissible fault rate in operating under the effect of impact loads. Damage to the skin of the leading edges of the wing, tail unit or aircraft air intake by foreign objects during take-off and landing or even a tool falling on a skin made of composite materials can lead to serious consequences. Such damages (in the form of internal cracks and delaminations) may be invisible to the naked eye, but nevertheless have a negative effect on structural strength. Impact strength of structures made of composite materials customarily is evaluated by the amount of relative breaking strain. Tests of graphite-epoxy composite materials (48 lamina of grade T300/5208) conducted in the United States showed that even with invisible damage the material may fail with a relative breaking strain equal to 0.005. Therefore to ensure proper flight safety the decision was made to establish the maximum value of relative breaking strain equal to 0.003 for aircraft structures made of graphite-epoxy composite materials.

Steps are being taken at the same time to increase impact strength of composite materials by weaving reinforcing fiber through their entire thickness, fabricating the composite materials in the form of a volumetric woven (three-dimensional) fabric, introducing special "stoppers" to the material which prevent crack propagation and so on. Information is available that these steps improve threshold values of the impact strength of composite materials by 25-30 percent in comparison with conventional materials. Meanwhile foreign specialists assert that a cardinal improvement of characteristics of the permissible fault rate of composite materials is possible only with the introduction of new binders to their matrices having a high interlaminar failure viscosity. Fig. 2 shows these characteristics for several generations of polymer binders. So-called first generation thermosetting polymers (5208, 3502 and others) based on epoxy resins have high compression strength and satisfactory polymerization temperature (177 degrees Centigrade), but insufficient failure strength. Second generation thermosetting polymers (1504, 2220 and others) have a higher (almost double) interlaminar failure strength, but they too do not satisfy modern requirements. Binders already have been developed [razrabotat] and are presently being used which are called thermoplastic polymers and which have a high failure strength (polysulfone, polyamide-imide and others), but they have poor resistance to solvents and polymerize at a very high temperature (370-425 degrees Centigrade) and pressure (1380 kPa).

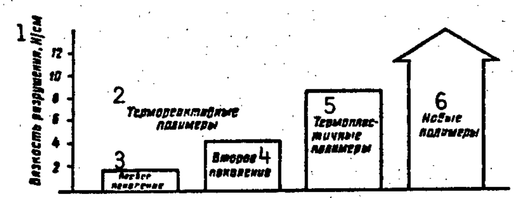


Fig. 2. Improvement in composite material matrices

Key:
1. Failure strength, N/cm
2. Thermosetting polymers
3. First generation
4. Second generation
5. Thermoplastic polymers
6. New polymers

Polycrystalline polymers (such as polyetheretherketone—PEEK) developed [razrabotat] by British specialists have shown good characteristics confirming potential opportunities for achieving high failure strength in combination with good compression strength even under conditions of increased temperature and humidity, as well as resistance to solvents. At the same time the opinion is that modern achievements in the field of polymer chemistry provide a basis to presume that these characteristics too may be improved in the near future. Table 2 gives comparative data of the contemporary epoxy material 5208 and the new APC2PEEK thermoplastic (UK), which possesses better characteristics.

Further studies by foreign specialists of composite materials having polymer materials as binders permitted identifying one other important property from a military standpoint—the capability of not reflecting, but absorbing radio waves in a certain frequency range. This makes an aircraft built using composite materials less noticeable to radars. A number of foreign sources state that the absorbing capacity of graphite-epoxy composite materials depends in particular on thickness of the material (number of lamina), shape of the entire structure made of composite materials, and frequency of the incident wave. For example, with a radar emitting a frequency of over 12 GHz a signal falling on the surface of a structure made of four-lamina composite materials becomes lower than the noise level, but the absorbing capacity of composite materials is lost at low frequency (below 1 GHz). The opinion is that by combining the number of lamina and placement orientation of the reinforcing fiber it is possible to achieve a substantial reduction in an aircraft's radar visibility, especially in centimeter wavebands.

Along with the work of studying properties of composite materials having various polymers as binders and of improving their physico-chemical characteristics, there are active studies abroad of composite materials with a

Characteristics	Composite Materials	
	5208	APC2PEEK
Interlaminar failure viscosity, N/cm	0.875	21
Compressive breaking strain (after impact damage with energy of 4.45 J/mm), percent	0.3	0.8
Polymerization regime:		
Temperature, °C	177	382
Pressure, kPa	587—690	1380
Curing time, hrs	3	0.5

matrix of light metal alloys (aluminum, titanium). Such composite materials have a number of advantages, above all high impact resistance, which is of decisive importance for using such materials in structures subject to impact loads in the process of operation (leading edges of wings and tail unit of the aircraft, air intakes, engine fan and compressor blades). For example, the United States registers over 400 instances annually of damage to leading edges of the aforementioned aircraft parts by foreign objects during take-off and landing, and because of collision with birds. According to American press data, expenses for eliminating the consequences of these incidents exceed an annual sum of $60 million.

It was determined in the course of studies that impact damage to composite materials by small objects leads basically to local failures, the size of which is limited to the area of contact at the moment of impact. The nature and magnitude of failure vary depending on the kind and thickness of material and the weight and velocity of the impacting body. For composite materials with polymer matrices such failures usually are more extensive and take the form of delaminations and splitting. These failures substantially degrade the overall strength of structures made of composite materials. Having greater impact resistance, composite materials with a metal matrix receive failures in the form of dents, punctures, and lateral and axial cracks when damaged by foreign objects. Such damage has a lesser effect on a decrease in strength of structures made of composite materials with tension or compression loads. As impact velocity increases the zone of local failure of composite materials increases until the damage assumes the form of a through hole. A further increase in impact velocity initially leads even to a certain reduction of the damage zone. The residual strength of composite materials changes inversely, but also retains a constant value with the very same magnitude of impact velocity corresponding to preservation of constancy of the through hole zone.

It was simultaneously determined that a hard composite material (such as boron-aluminum) has a higher initial impact strength in comparison with viscous composite materials (borsic-titanium). But as impact velocity increases, the failure zone of hard composite materials grows quickly and by the moment a through hole appears the material's residual strength drops 50 percent compared with initial strength. Borsic-titanium composite material has better crack resistance although with identical rigidity it has a tensile strength almost half that of boron-aluminum composite materials. The reduction in strength in this composite material with a through puncture did not exceed 20 percent during tests. The conclusion was drawn based on these studies that while the initial ultimate strength for the given structure is not determining, a more viscous composite material—borsic-titanium—is more preferable from the standpoint of preserving a safety factor during impact by foreign objects.

In conducting a comparative evaluation of the physicochemical properties of present and future composite materials with similar characteristics of metal alloys, foreign specialists note that composite materials have a deciding advantage in fatigue strength. This property of composite materials is explained by the fact that the reinforcing fibers not only have greater resistance than metals to repeat loads, but also provide a considerable off-loading of matrix material from fatigue stresses because of high rigidity. The appearance and growth of fatigue cracks in structures made of composite materials are prevented as a result. Documents of studies conducted in Great Britain state that realistically it is very difficult to obtain true fatigue failure in composite materials; therefore by using composite materials it is possible to achieve a significant improvement in fatigue characteristics compared with metal structures.

At the present time work continues abroad to improve the properties of composite materials. New raw material for producing an even stronger carbon fiber has been obtained in recent years: petroleum pitch and polyacrylonitrile (PAN). According to western press reports, the annual consumption volume of composite materials in the United States in 1984 exceeded 1,800 tons, and the forecast of its annual increase is 20-25 percent. The world production volume of high quality PAN carbon fiber in 1984 was assessed at close to 5,000 tons (1,300

tons in the United States, 2,700 tons in Japan and around 900 tons in Europe). With respect to more long-range forecasting of the use of composite materials in various technical devices (chiefly in articles of the aircraft and automobile industry), foreign specialists express two suppositions.

According to the first more optimistic forecast, which takes account of an improvement in characteristics of permissible failure rate of composite materials and their cost reduction as a result of assimilating the technology of their automated manufacture, the volume of composite material use in aircraft structures will rise to 60 percent by the year 2000, and the use of aluminum alloys will drop to 11 percent. The second forecast is made with respect to a slower improvement of composite materials. Under this forecast the volume of composite material use will not exceed 25 percent, and that of aluminum alloys will drop from 65 only to 54 percent (taking into account achievements of powder metallurgy and the introduction of aluminum-lithium alloys). The future will show which of the forecasts will be correct. Meanwhile it is noted that considerable successes have been achieved over the last decade in the field of development [razrabotka] and use of composite materials in aircraft structures, and that the process of further supplanting of traditional metal alloys by composite materials will continue.

Footnotes

1. See ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 10, 1984, pp. 52-57—Ed.

6904

American Experimental X-Wing Aircraft

18010332k Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 52-56

[Article by Col N. Nikolayev]

[Text] In an attempt to achieve greater effectiveness in the tactical employment of aviation, the Pentagon is working to create fundamentally new aircraft having the virtues both of a helicopter with vertical take-off and landing or in the hover mode, as well as of an aircraft in level flight. The following aerodynamic schemes are being considered in developing such craft:

—An aircraft with conventional wing, at the tips of which there are tilt-rotors with propellers. During vertical take-off and landing or in the hover mode the axes of the tilt-rotors with propellers are set in the vertical position and the propellers operate as helicopter main rotors, creating lift. For level flight the axes of the tilt-rotors with propellers occupy a horizontal position and create horizonal thrust. This scheme was tested in the experimental XV-15 aircraft, and presently the V-22 Osprey special-purpose aircraft are being developed under this scheme for the Air Force, Naval Aviation and the Army.

—An X-wing aircraft capable of executing a vertical take-off and landing as a helicopter with rotating wing and level flight with fixed wing. This aircraft scheme was studied theoretically and experimentally on models in wind tunnels and it is planned to conduct its practical test in the near future.

American specialists believe that compared with VTOL aircraft having turbojet engines creating lift, the advantage of an X-wing aircraft consists chiefly of significantly less fuel consumption in vertical take-off and landing. The chart (Fig. 1) shows the theoretical hourly fuel consumption for VTOL aircraft equipped with lift or lift-cruise turbojet or turbofan engines, the X-wing aircraft and helicopters as a function of the diameter of an equivalent main rotor. It follows from the chart that hourly fuel consumption for X-wing aircraft in a hovering mode is 3.5-4.5 times less than for VTOL aircraft and comparable with the hourly fuel consumption for helicopters.

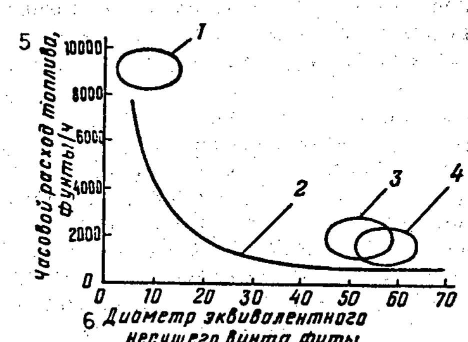


Fig. 1. Hourly fuel consumption in hovering mode as function of diameter of equivalent main rotor:

Key:
1. VTOL aircraft with turbojet lift engines
2. Theoretical minimum
3. X-wing aircraft
4. Helicopter (1 foot=0.30479 m; 1 pound=0.453592 kg)
5. Hourly fuel consumption, pounds/hr
6. Diameter of equivalent main rotor, feet

In addition it is believed that in the hovering mode the X-wing aircraft requires considerably less power-to-weight ratio (ratio of power plant output to aircraft weight) than for a VTOL aircraft, while requisite power-to-weight ratio in level flight is comparable with that of a VTOL aircraft (Fig. 2).

According to foreign press reports, studies of the X-wing aircraft scheme are being conducted under U.S. Defense Department direction by the National Aeronautics and Space Administration (NASA) and a number of aircraft

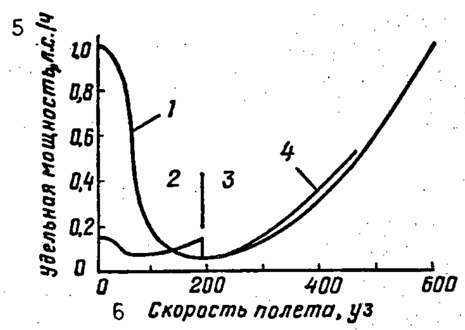


Fig. 2. Power-to-weight ratio as function of flight speed:
Key:
1. VTOL aircraft with turbojet lift engines
2. Helicopter mode
3. Fixed-wing mode
4. X-wing aircraft (1 knot=1.852 km/hr)
5. Power-to-weight ratio, hp/hr
6. Flight speed, knots

and helicopter construction firms. In 1983 NASA placed an order with the firm of Sikorsky for the sum of $77 million for development , manufacture and flight tests of a full-scale X-wing. The S-72 RSRA helicopter was chosen as an experimental helicopter for the flight tests.

In its aerodynamic scheme this helicopter, two models of which were built by Sikorsky and are being used by NASA for flight tests of main rotor systems, represents a rotor/wing with one main rotor, low straight tapered wing, straight horizontal tail and swept T-vertical tail with tail rotor. The diameter of the five-bladed main rotor is 18.9 m, disk area 280.5 m^2, wingspan 13.74 m, and wing area 34.37 m^2. The power plant consists of two T58 turboshaft engines each with 1,400 shaft hp (for the main rotor drive) and two TF34 turbofan engines each with a thrust of 4,200 kg(f) (for level flight). Weight of the empty helicopter is 9,535 kg, design take-off weight is 11,880 kg, maximum flight speed in helicopter mode is 300 km/hr, and in fixed-wing mode 550 km/hr.

Flight tests of the S-72 RSRA helicopter were conducted at the NASA Ames-Dryden Flight Research Facility beginning in May 1984 with the objective of checking the possibility of its flight in a fixed-wing mode without the main rotor. A total of 13 flights were made which confirmed the capabilities of the craft's flight in a fixed-wing mode at a speed up to 485 km/hr at altitudes up to 3,000 m.

Modernization of the S-72 RSRA helicopter with the objective of flight testing the X-wing consisted of fabrication and installation on the aircraft of an X-wing, a pneumatic flight control system, compressor for delivering compressed air to the system, transmission for driving the compressor from the turbofan engines, wing rotation brake, and an assembly for fixing and locking the wing in a fixed position (Fig. 3).

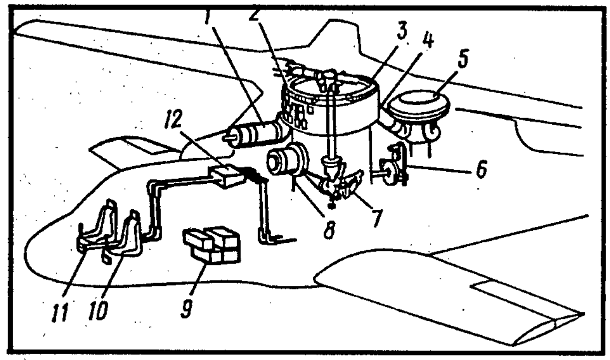


Fig. 3. Diagram of S-72 RSRA helicopter modification for X-wing flight tests:
Key:
1. T-58 engines
2. Pneumatic control valves
3. Pressure chamber
4. Compressor outlet valve
5. Compressor
6. Wing brake and wing fixing and locking assembly
7. Mechanical linkage for controlling collective rotor pitch
8. Clutch box
9. Flight control computer
10. Copilot seat
11. Test pilot seat
12. Existing mechanical control links of S-72 RSRA helicopter

Being simultaneously a main rotor, the X-wing consists of four cantilevers (blades) situated in the same plane at a 90 degree angle to each other. Each blade has a symmetrical profile relative to the central spar (Fig. 4) with maximum thickness of 50 percent chord. Wing diameter is 17.9 m, chord length of constant-span blade 0.91 m, area of each blade 0.62 m^2, wing/main rotor disk area 242.6 m^2. The blade design is single-spar with skin under torsion. The I-spar and skin are made of composite material with carbon-fiber reinforcement. The blades are attached hingeless to a titanium alloy rotor hub. The collective pitch of the blades can be changed by mechanical linkage within limits of an angle of plus or minus 10 degrees.

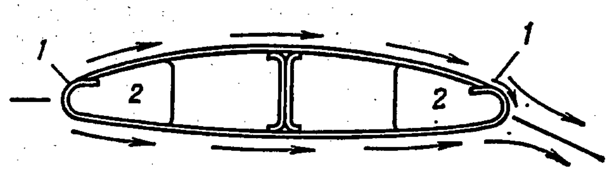


Fig. 4. Diagram of X-wing blade profile:
Key:
1. Slot
2. Compressed air

Slots through which air is blown for controlling blade circulation, i.e., to control their lift, are located along the

span of the blades near their leading and trailing edges. During wing rotation in the helicopter mode air is blown out through the slots at the rear edges of the blades (counterclockwise wing rotation), but in the fixed-wing mode it is blown out of the left blades through slots of the leading edges (these edges are the trailing edges for blades viewed as wing panels), and in the right blades through slots of the trailing edges (Fig. 5). The slots are closed by spring-loaded flaps opening only with excess air pressure above 0.42 kg/cm^2.

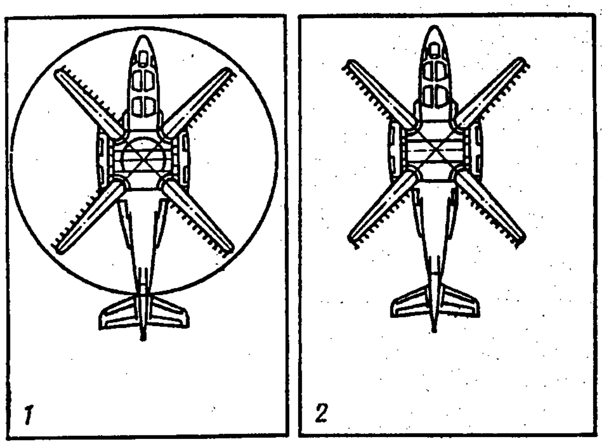


Fig. 5. Diagram of air blow-out through slots at blade leading and trailing edges:

Key:
1. Helicopter mode (counterclockwise rotation of main rotor/wing)
2. Fixed-wing mode

The pneumatic control system located beneath the X-wing main rotor/wing hub is considered the most complex component. A special double-stage axial-flow compressor with maximum output pressure differential up to 1.4 kg/cm^2 is installed to deliver compressed air to this system and on to blade slots; air is delivered from the compressor to a circular pressure chamber situated around the shaft which rotates the wing (Fig. 6). Air is delivered from the pressure chamber through a system of valves along two lines in each blade to slots at the blade leading and trailing edges. Air delivery to the slots through the system of valves is regulated by the flight control system depending on regimes and requirements for overall wing lift and cyclic lift control. In addition, main rotor/wing vibrations can be damped by cyclic delivery of air to the slots.

Rotation of the wing (for its operation as a main rotor) and the compressor (for delivering air to the pneumatic control system) is accomplished through a transmission from two T58 turbofan engines. The modernized helicopter's transmission includes a clutch, wing rotation brake and a special device for fixing and locking the wing in a fixed position for level flight.

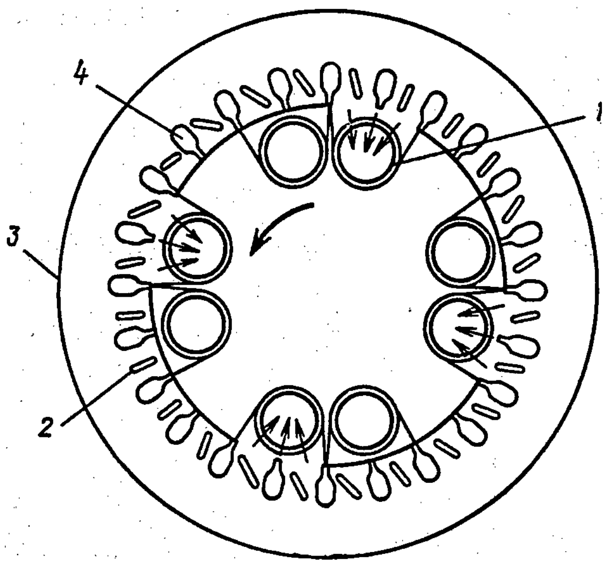


Fig. 6. Diagram of compressed air supply to slots in main rotor/wing blades:

Key:
1. Air supply line to trailing edge slot
2. Throttle valve
3. Stationary pressure chamber
4. Rotating collector

The conventional wing of the aircraft has a wing aspect ratio of 5.52, root chord of 2.93 m, and tip chord of 1.95 m. The wing structure is two-spar and is made of aluminum alloys. The trailing edge of the wingtip accommodates conventional ailerons and the wing root accommodates slotted flaps. The tail unit includes a variable-incidence tailplane with elevator and vertical swept fin with a small horizontal tailplane at the upper end. A two-bladed tail rotor is mounted on the fin.

Pitch and bank control of the aircraft in the helicopter mode is by a cyclic supply of air for blow-out through the blade slots, and yaw control is by the tail rotor. Pitch control in the fixed-wing mode is accomplished by the variable-incidence tailplane and elevator, and bank control by ailerons. Bank control can be reinforced by asymmetric blow-out of air through blade slots. Direct control of aircraft lift can be accomplished by symmetric blow-out of air through the blade slots.

A digital flight control system is installed in the experimental aircraft which includes four computers of the general flight control system and two computers of the automatic flight control system. They produce control signals for air delivery to blade slots, use of the wing rotation brake in transition flight regimes, clutch operation, mechanical drives of collective blade pitch, aerodynamic surfaces, and engines.

The X-wing craft has the very same power plant as the S-72 RSRA helicopter: two T58 turboshaft engines for rotating the wing and compressor and two TF34 turbofan engines for cruising flight in the fixed-wing mode. The fuel reserve is in two fuselage tanks with a capacity

of 2,540 liters; usable fuel capacity is 2,480 liters. The crew consists of two pilots accommodated on ejection seats in a nonpressurized cockpit.

The craft's maximum take-off and landing weight is 15,100 kg, maximum flight speed in fixed-wing mode at an altitude of 1,500 m is around 580 km/hr, cruising speed at this same altitude is 370 km/hr, maximum rate of climb at sea level is 867 m/min, and service ceiling is 3,050 m. In the fixed-wing mode the craft can take off with a run of 500 m and take-off distance (until reaching a height of 15 m) of around 550 m. Landing distance in this mode is 1,150 m and the landing run is 575 m.

Fabrication of the X-wing and individual components for modifying the S-72 RSRA helicopters, their bench tests, as well as modernization of the helicopter as a whole were completed in August 1986. In late 1986 the experimental X-wing aircraft was delivered to the NASA Ames-Dryden Flight Research Facility for flight tests which were to begin in the fall of 1987 (Fig. 7 [figure not reproduced]). Inasmuch as the lift created by the X-wing in a helicopter mode is less than the aircraft's take-off weight it is planned to conduct its tests with a running take-off and landing.

It is planned to carry out the flight test program in four phases. In the first phase in order to determine basic aerodynamic characteristics and flying qualities of the aircraft (inasmuch as its flying weight and position of the center of gravity were changed), flights in the fixed-wing mode first will be made without the X-wing and then with wing installed in a fixed position without using the circulation control. These tests will be conducted with manual control of the craft without using the X-wing pneumatic control system. In the second phase it is planned to study the X-wing circulation control system in level flight with the X-wing fixed in a stationary position. The third phase provides for ground tests of the X-wing in a helicopter mode. Basic tasks of the flight test program consisting of a check of transition flight modes from helicopter to fixed-wing and back will be accomplished in the fourth phase.

Using results of flight tests of the X-wing and design studies, Sikorsky plans to build a demonstration model of the X-wing aircraft by the beginning of the 1990's. Its power plant is to consist of two turboshaft engines each with 2,500 shaft hp which rotate variable-pitch fans to create thrust in level flight. The craft's design flying weight is 10,000-11,000 kg, cruising speed in the fixed-wing mode around 500 km/hr, flight speed in the transition from helicopter to fixed-wing mode 350-370 km/hr.

According to the western press, the U.S. Armed Forces are interested in using aircraft having capabilities for vertical take-off and landing as well as high efficiency in a hovering mode and level flight in a fixed-wing mode. It is believed that the X-wing aircraft will meet these requirements. In the opinion of American military specialists, an aircraft with those characteristics can be used in the Navy for operations against submarines and surface combatants, for radar early warning, electronic warfare, and search and rescue operations (depending on the variant of outfitting with weapons and special equipment).

In its plans Sikorsky is considering possibilities of developing an X-wing aircraft intended for accomplishing such missions by the year 2000. It is planned to install two convertible turbofan engines on it. The design take-off weight of the craft is 17,000-18,000 kg and cruising speed is 880 km/hr.

6904

Status and Principal Directions of Development of NATO Navies

18010332l Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 57-64

[Part 1 of article by Capt 2d Rank Yu. Kravchenko]

[Text] The North Atlantic Alliance military-political leadership considers naval forces to be the most important instrument for achieving its aggressive goals. In peacetime they are widely used to show force, to exert direct military pressure on states conducting an independent foreign policy, and to provide a "defense of interests" of imperialism in key regions of the globe.

In wartime NATO Allied Naval Forces are to accomplish missions of delivering nuclear missile strikes against enemy territory, winning and holding supremacy in ocean and sea combat areas, protecting lines of communication, conducting landing operations, and a number of other missions.

Based on open foreign press materials, this article considers the status and principal directions of development of NATO navies.

The **United States of America** has the largest and most modern naval forces among world capitalist states.

As of the beginning of 1988 counting the ready reserve (40 units), they had over 460 ships, around 90 auxiliary vessels of various types, and over 60 Military Sealift Command vessels. Naval and Marine Aviation has a significant striking force—up to 5,600 aircraft and helicopters, of which approximately 2,500 are combat craft including nuclear weapon platforms. By the early 1990's a significant increase (to 600 units) is expected in the overall number of combatant ships and mobile logistic support and service vessels. After this it is planned to maintain the level reached with an optimum ratio of

Ship or Vessel Class	Fiscal Years					Total for 1988-1992
	1988	1989	1990	1991	1992	
Construction						
"Ohio"-Class SSBN's...	1	1	1	1	1	5
Multirole SSN Classes:						
"Los Angeles".......	3	2	2	2	1	10
"Seawolf"...........	—	1	—	2	2	5
"Chester W. Nimitz"-Class CVN's.........	—	—	1	—	—	1
"Ticonderoga"-Class CG's................	2	2	1	—	—	5
"Arleigh Burke"-Class DDG's..............	3	3	3	5	6	20
"Wasp"-Class LHD's....	1	1	—	1	—	3
"Whidbey Island"-Class LSD's (Cargo Variant)............	1	—	1	1	2	5
"Avenger"-Class MCM's..............	3	—	—	—	—	3
Coastal Minehunters (MHC)...............	—	2	3	3	4	12
Patrol Craft (PCM)....	—	—	1	—	4	5
AOE 6-Class Combat Support Ships.......	—	1	—	2	—	3
AE 36-Class Ammunition Ships..............	—	—	—	1	1	2
Salvage Ship (ARS)....	—	—	1	—	—	1
AO 187-Class Oilers...	2	2	2	1	—	7
Long-Range Sonar Surveillance Ships T-AGOS..............	—	3	3	2	—	8
Oceanographic Research Ships (AGOR)........	—	1	2	4	—	7
Total.................	16	19	21	25	21	102
Refitting						
Multi-purpose aircraft carrier (SLEP)......	1	—	—	1	—	2
Oilers (AO)...........	1	2	1	—	—	4
Crane Ships (T-ACS)...	2	2	—	—	—	4
Total..................	4	4	1	1	—	10
Grand Total...........	20	23	22	26	21	112

different types of ships. The naval command believes that keeping that numerical strength of the fleet over the next decade will require commissioning at least 20 ships annually. Presently around 80 naval combatant ships and vessels are in various stages of construction or refitting at 17 shipyards. The table shows the number of ships and vessels for which it is planned to allocate funds for construction and refitting under the five-year shipbuilding program for 1988-1992.

Nuclear-powered ballistic missile submarines hold a special place in the structure of naval forces. They form the *strategic sea-based nuclear forces*. They include 36 SSBN's: 8 of the latest "Ohio"-Class and 28 "Lafayette"-Class[1]. In the period from 1985 through 1987 three submarines—the SSBN 731 "Alabama," SSBN 732 "Alaska" and SSBN 733 "Nevada"—were commissioned in the Navy's combat-ready forces, the SSBN 734 "Tennessee" is being fitted out afloat, three are on the

building ways and one has been ordered. Three "Lafayette"-Class SSBN's—the SSBN 623 "Nathan Hale," SSBN 635 "Sam Rayburn" and SSBN 636 "Nathaniel Greene"—were removed from combat-ready status with dismantling of missile compartments in accordance with the Treaty on Limitation of Strategic Offensive Arms (SALT II). In accordance with the U.S. military budget for fiscal years 1988 and 1989, it is planned to place orders for building another two "Ohio"-Class submarines, the 15th and 16th in the series. The naval command plans to bring the total number of such SSBN's to 24, keeping the average annual rate of their construction at the level of one submarine, at least over the next five years.

At the present time there are two missile weapon systems in the inventory of U.S. Navy nuclear-powered ballistic missile submarines: Trident I (C-4) with a range of fire of 7,400 km (MIRV re-entry vehicle with eight 100 KT warheads) and Poseidon C-3 with a range of fire of 4,600 km (MIRV, 10x50 KT). The Trident I ballistic missiles are in all 8 "Ohio"-Class SSBN's and 12 "Lafayette"-Class SSBN's, each of which carries 24 or 16 SLBM's respectively.

Test launches of the new Trident II (D-5) ballistic missiles with a range of fire over 11,000 km (MIRV, 14x150 KT or 7x600 KT) began in January 1987. Compared with the Trident I, in addition to increased cumulative yield of the re-entry vehicle and greater flight range, this missile has a considerably smaller circular error probable (around 100 m). It is planned to make a total of up to 30 launches, including 10 from SSBN's. In case of this program's successful conclusion, submarines will begin to be armed with the missiles in 1989. The first SSBN on which they are to be deployed will be the SSBN 734 "Tennessee," 9th in the series of "Ohio"-Class submarines, and the first eight of this class will be fitted out with them during scheduled major overhauls. In fiscal years 1988 and 1989 it is planned to allocate funds for purchasing 132 Trident II ballistic missiles.

Combat patrols of nuclear-powered missile submarines are characterized by rather high stress. For example, according to data of the journal JANE'S DEFENCE WEEKLY, in 1986 American "Ohio"- and "Lafayette"-Class SSBN's put to sea 88 times on combat patrol, including 21 patrols with the Trident I SLBM aboard. The patrol cycle for "Ohio"-Class SSBN's is 95 days (70 at sea and 25 days for between-deployment repairs and base training) and for "Lafayette"-Class SSBN's it is 100 days (68 and 32 days respectively).

The *general purpose forces*, which include combatant ships of all types (with the exception of SSBN's) as well as auxiliary vessels, represent the basis of the American Navy numerically.

Submarines are one of the principal naval arms and the naval command gives special attention to their development. Nuclear-powered multirole submarines (SSN's), which have essentially unlimited endurance and great concealment and which are armed with modern missile, torpedo and mine ordnance systems including medium-range cruise missiles, are capable of accomplishing a wide range of missions and playing an appreciable role in any operations conducted by the Navy.

Judging from data of the "Jane's" reference on ship order of battle, submarine forces of the Atlantic and Pacific fleets number 99 nuclear-powered multipurpose submarines and 4 diesel submarines.

"Los Angeles"-Class SSN's (39 units) are the most modern in the American Navy. It is planned to have a total of 70 such submarines. Their average annual construction rate has been maintained at the level of 3-4 units up to the present time but, as noted in the draft U.S. Armed Forces Budget for Fiscal Years 1988-1989, the annual rate possibly will be reduced to two SSN's.

Certain changes were made to the project during construction of this class of submarine. For example, submarines armed with the Tomahawk cruise missile began to be delivered to the Navy beginning with SSN 719 "Providence" (12 vertical launchers forward outside the pressure hull). In addition, it is planned to modernize some SSN's (beginning with the SSN 751 "San Juan") with the objective of increasing their capabilities to conduct combat actions under arctic conditions by reinforcing mast fairwaters, the forward end, and stern control surfaces; replacing fairwater planes with retractable bow planes; modernizing the AN/BQS-15 short-range sonar; and reducing noise.

In addition to "Los Angeles"-Class submarines, the following classes of SSN's were on the rolls of the U.S. Navy as of the beginning of the current year: "Sturgeon" (37 units, commissioned during 1967-1975), "Permit" (13, 1962-1967), "Skipjack" (4, 1959-1961), "Skate" (1958), "Glenard P. Lipscomb" (1974), "Narwhal" (1969), "Tullibee" (1960), as well as 2 "Ethan Allen"-Class submarines—former SSBN's which after refitting are being used as amphibious transports for special-purpose forces.

In 1987 the SSN 575 "Seawolf" and SSN 583 "Sargo" were decommissioned and the SSN 578 "Skate," SSN 592 "Snook," SSN 586 "Triton" and SSN 587 "Halibut" were written off by the Navy.

The United States continues to keep four diesel submarines in commission: three "Barbel"-Class and one "Darter"-Class. They are used chiefly in support of combat training of naval ships. Three submarines are based in the Pacific and one in the Atlantic. Construction of new diesel submarines is not envisaged in the near future.

Under plans for development of submarine forces it is intended to begin building a new series (up to 30 units) of nuclear-powered multipurpose submarines of the SSN

21 "Seawolf"-Class in the late 1980's. Funding for the lead SSN is planned for 1989. The foreign press reports that the new submarines will have less noise, greater speed and submergence depth, and increased capabilities for operating beneath the ice in arctic areas.[2] Her design tactical-technical characteristics are: a surface displacement of 9,200-9,800 tons, a length of 100-107 m, beam of around 12 m, nuclear power plant output of 48,000-56,000 hp, and maximum submerged speed of 34-36 knots; her armament consists of eight torpedo tubes (610-762 mm) and modern systems of antisubmarine and antiship weapons.

Carrier strike forces comprise the basis of combat might of modern general-purpose naval forces. The order of battle of naval forces presently includes 15 multipurpose aircraft carriers: five nuclear-powered carriers (four "Chester W. Nimitz"-Class and the "Enterprise") as well as ten with steam power plants (four "Kitty Hawk"-Class including the CV 63 "Kitty Hawk," which is undergoing major overhaul and modernization under the SLEP program; four "Forrestal"-Class; and two "Midway"-Class). Organizationally the multipurpose carriers are part of the air forces of the Atlantic and Pacific fleets. The Naval Reserve has the CVA 31 "Bon Homme Richard," CV 34 "Oriskany," CVS 12 "Hornet" and CVS 20 "Bennington," all built during World War II (1943, 1944) with the exception of the "Oriskany" (1950). The carrier AVT 16 "Lexington" (1943) is a training carrier and part of the Naval Training Command.

A program for building nuclear-powered "Chester W. Nimitz"-Class carriers continues. The CVN 71 "Theodore Roosevelt," the fourth ship of this series, was commissioned in October 1986. As the foreign press reported, this was one and a half years earlier than the planned date. CVN 72 "Abraham Lincoln" was launched in the fall of last year and is planned to be turned over to the Navy in early 1990. Completion of construction on the sixth carrier, the CVN 73 "George Washington," is expected by 1992. She is to replace the carrier CV 43 "Coral Sea" built in the late 1940's, which in turn will be reclassified as a training carrier and will take the place of AVT 16 "Lexington."

The budget for fiscal years 1988-1989 intially is allocating $1.4 billion for building another two nuclear-powered "Chester W. Nimitz"-Class carriers (CVN 74 and 75). The commissioning of the first, CVN 74, will permit removing the carrier CV 41 "Midway" from the combat-ready forces and commissioning of CVN 75 will permit removing the carrier CV 59 "Forrestal" (by 1999). The western press notes that with the fulfillment of this program the Navy will be able to have 15 carriers constantly in the combat-ready forces.

In addition to building new ships it is planned to continue implementing the Service Life Extension Project (SLEP) for existing carriers. Major overhauls and modernization lasting 2-3 years should ensure an extension of the service life of ships by 15 years. Two "Forrestal"-Class ships already have undergone this: CV 60 "Saratoga" (1980-1983) and CV 59 "Forrestal" (1983-1985). Subsequently it is planned to perform work under the SLEP project on other carriers with conventional power plants: CV 64 "Constellation" (1990-1993), CV 61 "Ranger" (1993-1996), CV 66 "America" (1996-1999), CV 67 "John F. Kennedy" (1999-2002). It is not planned to modernize the carriers CV 41 "Midway" and CV 43 "Coral Sea."

The Navy's carrier-based aviation represents a considerable force.[3] It numbers over 1,300 combat aircraft and helicopters in 13 air wings, and activation of one more wing is concluding. In addition, two wings are in the Naval Air Reserve. A check continues of three new type variants of air wing order of battle (multipurpose, medium-range attack and long-range attack) in the course of working operational and combat training measures.

Judging from foreign press reports, development of the deck-based aviation inventory is to be carried out in the direction of increasing deliveries to the Navy of modern F/A-18 Hornet fighter-attack aircraft, which by 1990 should replace the A-7E Corsair II light attack aircraft, as well as by modernizing existing aircraft types: F-14A Tomcat fighters, A-6E Intruder attack aircraft, S-3A Viking antisubmarine aircraft and others.

The work of demothballing and modernizing the fourth "Iowa"-Class battleship, the BB 64 "Wisconsin," has entered the final stage. After she is handed over to the Navy (tentatively in the latter half of this year) the U.S. Navy can form four missile striking forces. Rather serious attention presently is being given to developing tactics of combat employment of battleships and to checking the tactics during exercises both as part of carrier striking forces as well as independently.

The decision to demothball ships of this type was facilitated not only by the circumstance that battleships can be a platform for accommodating the Harpoon antiship missile system and Tomahawk cruise missiles, but also by the desire to realize the unique capabilities of the 406-mm primary gun armament (projectile weight 860-1,225 kg). To this end work is under way to modernize the fire control system of the main guns, and to develop new projectiles for them with increased range of fire. It is planned to implement these improvements by 1992. In addition, last year tests of Israeli-made Pioneer drones were conducted aboard the battleship "Iowa." The Navy command plans to employ them at a range up to 185 km to accomplish missions of reconnoitering sea and coastal targets, spotting gunfire and assessing results of strikes.[4]

Cruisers, destroyers and frigates hold an important place in the general-purpose forces. They are intended chiefly for providing antiaircraft and antisubmarine defense of fleet task forces and convoys on the sea transit, engaging enemy surface combatants, and accomplishing fire support missions.

As of the beginning of this year the regular American Navy had 36 guided missile cruisers, including 9 nuclear-powered (four "Virginia"-Class, two "California"-Class as well as the "Truxtun," "Bainbridge" and "Long Beach") and 27 with conventional power plants—"Ticonderoga"-Class (9), "Belknap"-Class (9) and "Leahy"-Class (9).

Construction of "Ticonderoga"-Class guided missile cruisers continues (Fig. 1 [figure not reproduced]). It is planned to have a total of 27 such ships in the Navy and the construction rate is being kept at an average level of three ships per year. The shipbuidling program (1988-1992) provides for making appropriations for building the last five ships of the series, two each in fiscal years 1988 and 1989 and one under the FY 1990 budget. Beginning with the CG 52 "Bunker Hill" (the sixth ship in the series, see color insert [color insert not reproduced]), cruisers are being fitted with two Mk 41 vertical launchers (for firing the Standard SM-2 surface-to-air missiles, Tomahawk cruise missiles and ASROC anti-submarine rockets) in place of the Mk 26 twin launchers. As aboard the first ships of the series, two four-container Harpoon antiship missile system launchers are accommodated aft behind the 127-mm gun mounting.

The foreign press emphasizes that nuclear-powered guided missile cruisers may be part of nuclear-powered carrier striking forces. All of them are equipped with the Harpoon antiship missile system, and hardened launchers for the Tomahawk cruise missiles are installed aboard "Virginia"-Class and "Long Beach"-Class cruisers.

U.S. Navy destroyers (68 units, including 37 guided missile ships) are represented by four classes: "Kidd" (4), "Coontz" (10), "Charles F. Adams" (23) and "Spruance" (31). The "Forrest Sherman"-Class destroyer DD 946 "Edson" is in the ready reserve. By the mid-1990's "Coontz"- and "Charles F. Adams"-Class guided missile destroyers are planned to be decommissioned after 30 years of service. They will be replaced by "Arleigh Burke"-Class ships with the Aegis multipurpose weapon system aboard. It is planned to build a total of 29 guided missile destroyers of this class.[5] The "Kidd" and "Spruance" will remain in the naval order of battle until 2005-2010.

Practically all destroyers are armed with the Harpoon antiship missile system, and launchers are installed aboard "Spruance"-Class ships for firing Tomahawk cruise missiles (including vertical launchers aboard 24 of them).

The program for building a series of "Oliver H. Perry"-Class guided missile frigates (50 units commissioned, including 12 in the ready reserve) is coming to an end. The last such ship should be turned over to the Navy in late 1988. In addition, the Navy has 6 "Brooke"-Class guided missile frigates and 59 frigates of various classes: 46 "Knox"-Class (7 in the ready reserve), 10 "Garcia"-Class, 2 "Bronstein"-Class and one "Glover"-Class. The U.S. Navy command does not plan to build frigates of new designs in the near future. By 1990 it is planned to turn over another seven ships of this class—six "Oliver H. Perry"-Class and one "Knox"-Class—to the ready reserve.

U.S. Navy amphibious forces are intended for supporting rapid deployment of marine expeditionary formations in remote areas and landing them over the beach under conditions of heavy enemy opposition.

As of the beginning of this year the regular naval forces have 61 landing ships and transports including 2 command ships ("Blue Ridge"-Class), 5 general purpose ships ("Tarawa"-Class), 7 amphibious assault ships ("Iwo Jima"-Class), 13 amphibious transport docks (2 "Raleigh"-Class and 11 "Austin"-Class), 18 tank landing ships ("Newport"-Class), 11 dock landing ships (3 "Whidbey Island"-Class, 5 "Anchorage"-Class and 3 "Thomaston"-Class), as well as 5 cargo transports ("Charleston"-Class). In addition, two "Newport"-Class ships are in the ready reserve and five "Thomaston"-Class are mothballed. The foreign press indicates that the naval and amphibious forces can deliver 1.15 marine expeditionary divisions to landing areas and place them ashore.

A program for their modernization and build-up presently is being carried out. With its completion in the 1990's, the American naval command believes it will be possible to support the overseas move and landing of a marine expeditionary division and an expeditionary brigade.

Construction of "Wasp"-Class amphibious assault ships, "Whidbey Island"-Class dock landing ships, and LCAC-Class air cushion landing craft is under way in accordance with the shipbuilding program.

"Wasp"-Class amphibious assault ships (11 units in the series) are a further development of "Tarawa"-Class ships. The lead ship of the series, LHD 1 "Wasp," was launched in the fall of last year and is being fitted out afloat. It is expected that she will be turned over to the fleet in 1989. A second ship was ordered in 1986. Funds for constructing a third, fourth and fifth will be allocated in fiscal years 1988, 1989 and 1991 respectively. With the commissioning of the sixth amphibious assault ship of this class the naval command plans to begin replacing "Iwo Jima"-Class amphibious assault ships. The new amphibious assault ship with a full displacement of around 40,000 tons will take aboard over 1,800 Marines who can be placed ashore by 42 CH-46 Sea Knight medium assault helicopters and 3 LCAC-Class air cushion landing craft.

"Whidbey Island"-Class dock landing ships (Fig. 2 [figure not reproduced]) will replace "Thomaston"-Class ships. At the present time three dock landing ships

already have been turned over to the fleet (LSD 41 "Whidbey Island," LSD 42 "Germantown" and LSD 43 "Fort McHenry") and another five are in various stages of construction. They were designed with consideration for accommodating up to four air cushion landing craft aboard the dock landing ship. The shipbuilding program (1988-1992) provides for appropriations for building another five ships of this class in a new modification (cargo version). It is planned to have a total of six such dock landing ships.

A large-scale program for building LCAC-Class fast air cushion landing craft is being implemented. The great attention given to adopting such craft in the Navy (maximum speed 50 knots, range 300 nm at 35 knots, cargo capacity 60 tons) is explained by the U.S. Navy command's desire to increase the safety of landing ships by removing the areas of their anchorage and maneuvering during the landing to 30 nm or more from shore. Around 10 LCAC already have been turned over to the Navy; it is planned to have a total of over 90 of them.

Work continues to develope the MV-22A Osprey vertical take-off aircraft for the Marines; it is to replace CH-46 Sea Knight helicopters beginning in 1992-1993. The aircraft will be able to take aboard 24 Marines with full combat equipment and make two trips to a distance of up to 100 nm from the ship without refueling (maximum payload around 4,500 kg).

U.S. Navy minesweeping forces have 21 "Aggressive"-Class ocean minesweepers (MSO) built in the 1950's (including 18 in the ready reserve), the new MCM 1 "Avenger"-Class mine countermeasures ship, and two squadrons of RH-53D minesweeping helicopters (22 units).

Plans for future development envisage constructing "Avenger"-Class mine countermeasures ships—14 units in the series with full displacement of 1,040 tons—to replace obsolete ocean minesweepers. As of the beginning of 1988 there are 10 ships in various stages of construction, and appropriations for the last three will be made in the FY 1988 budget.

The foreign press reports that for technical reasons construction of "Cardinal"-Class ships (MSH) will be stopped. These minesweeper hunters were intended for performing minesweeping operations in water areas of naval bases and ports and coast sea fairways. At the present time the Navy has begun building minehunters/sweepers (17 units in the series) based on the design of Italian "Lerici"-Class ships (MHC). Funds for building the lead ship were allocated from the FY 1986 budget; the five-year shipbuilding program envisages financing 12 MHC-Class minehunters/sweepers.

The delivery of new MH-53E minesweeping helicopters to the Navy began last year; they are to replace the RH-53D built in the 1960's. It was planned to purchase 44 helicopters. In comparison with those in the inventory, the new craft can provide considerably greater tractive force (up to 13.6 tons) and time in the air (up to 6 hours). Modern on-board equipment largely permits automating flight control processes.

The American naval command believes that implementation of programs presently existing for replacing the minesweeping forces (14 "Avenger"-Class ships, 17 MHC-Class ships and 44 MH-53E helicopters) will be able to meet the Navy's requirement only partially.

Considerable attention is being given to building "Stalwart"-Class long-range sonar surveillance vessels (full displacement of 2,400 tons) equipped with the SURTASS towed system and intended for detecting submarines in ocean areas beyond coverage limits of the stationary SOSUS system. Of the 18 vessels of this class planned for construction, 10 were turned over to the Navy last year and the rest are in various stages of construction. A lead catamaran-type vessel of new design (SWATH) with a displacement of 3,800 tons was ordered in October 1986. Construction of eight such vessels is being financed under the five-year shipbuilding program. ??? Development of a mobile logistic support system envisages construction of 4 fast general-purpose supply transports and 19 replenishment oilers. By the early 1990's the U.S. Navy plans to have 8 general-purpose supply transports (4 "Sacramento"-Class built in the latter half of the 1960's and 4 of a new design) as well as 29 replenishment oilers (5 "Wichita"-Class, 5 "Cimarron"-Class and 19 of the new "Henry Kaiser"-Class).

According to foreign press reports, by 1990 the American Navy order of battle can have 38 nuclear-powered missile submarines, 100 nuclear-powered multipurpose submarines, 16 aircraft carriers (including 6 nuclear-powered), 4 battleships, around 230 cruisers, destroyers and frigates, 30 minesweeping ships and 65-67 landing ships and vessels.

(To be concluded)

Footnotes

1. For more detail on U.S. Navy submarine forces see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 12, 1987, pp 53-57—Ed.

2. For more detail on the design of the new american SSN 21 "Seawolf" see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 3, 1986, pp 60-61—Ed.

3. For more detail on U.S. Naval Aviation see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 8, 1987, pp 45-53; and No 9, 1987, pp 43-47—Ed.

4. For more detail on battleships see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 1, 1987, pp 57-62—Ed.

5. Concerning the destroyer DDG 51 "Arleigh Burke" see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 12, 1985, pp 84-85—Ed.

6904

Radionavigation Systems of U.S. Navy and Other NATO Navies

18010332m Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 64-68

[Article by Col R. Dasayev]

[Text] Modern warfare requires reliable navigation support permitting rapid and highly accurate position finding for highly maneuverable combat actions in ocean and sea theaters of military operations, for deployment of naval forces in given areas, and for effective employment of weapons against small targets. Long-range and short-range navigation electronic systems, which have been continuously developed and perfected over the last 20-30 years, are among the most important means of navigation support.

Radionavigation systems (RNS) began to be used for the first time during World War II. In connection with wide development of autonomous inertial navigation systems (INS) in the late 1950's some specialists of NATO navies expressed the opinion that radionavigation systems lacked promise because of their great vulnerability and possibility of their use by the enemy. Experience in operating inertial navigation systems, however, showed that they cannot completely replace radionavigation systems inasmuch as their accuracy depends on duration of a cruise or flight. Therefore the U.S. Navy command believes that only the integrated use of inertial and radionavigation systems will provide the Navy with accurate navigation data.

At the present time long-range and short-range navigation electronic systems providing continuous position finding have become widespread in the United States and other NATO countries. It is customary to include systems with an effective range over 400 km among the long-range systems. Short-range systems have a lesser effective range but are characterized by higher accuracy.

According to foreign press reports, NATO navies use the Transit satellite navigation system (SNS), the LORAN-C and Omega radionavigation systems, as well as the British Decca radionavigation systems as means of long-range navigation. In the early 1990's the United States intends to adopt the global NAVSTAR satellite navigation system; judging from statements by the American command, it will replace all existing long-range radionavigation systems. Basic features, tactical-technical characteristics and proposed dates for adoption of long-range radionavigation systems and their removal from the inventory are given in Table 1.

The **Transit satellite navigation system** (adopted in 1964) is intended for supporting the navigation of submarines and surface combatants in any part of the ocean.

It includes a space and a ground complex as well as user equipment. The system presently uses five satellites in circular polar orbits 1,075 km high, four ground complex stations and around 30,000 sets of user equipment, of which over 300 are military.[1]

System	Range, km	Accuracy, m	Operating Frequencies, MHz	Note
United States				
Transit satellite navigation system	Global	200	100 & 150	Will be removed from inventory in mid-1990's
LORAN-C radionavigation system	To 4300	100—500	0.1	Same as above
Omega radionavigation system	Global	3700—7400	0.01—0.013	Same as above
NAVSTAR satellite navigation system	Global	16	1575.42 1227.6 1783.74 2227.5	Will be adopted in the early 1990's
Great Britain				
Decca radionavigation system	To 1000	200	0.07—0.13	•

In the opinion of foreign specialists, the system's principal deficiency is that satellite signals needed for navigation cannot be received by users continuously, but every 30-90 minutes depending on geographic latitude.

The **LORAN-C radionavigation system**[2] is widely used by submarines and surface combatants as well as by aircraft of NATO navies.

According to its principle of operation it is a pulsed hyperbolic navigation system with time interval count based on the phase of a high-frequency pulse filling carrier. The user's location is determined from the time difference of receiving exactly synchronous signals from two or three pairs of ground stations. Each pair permits obtaining a line of position on the chart in the form of a hyperbola, with their intersection being the user's location. The system uses a band of long waves which propagate rather stably and have relatively small attenuation in the atmosphere, permitting signals to be received from ground stations at distances up to 4,300 km. The ground stations are located in chains of 3-5 stations, one of which is the master and the others are slaves. Their emissions are a group of pulses with repetition frequency established for a given chain. The master station's group contains nine pulses, and a slave's group contains eight.

At the present time some 20 chains including over 50 ground stations are deployed at various points on the globe.

The **Omega global radionavigation system** is intended for position finding by aircraft, surface combatants and submarines. In addition, it can be used in the search and rescue of crews of aircraft and ships in distress as well as in various research in remote areas which do not have navigation support.

Because of the chosen band of superlong waves, the Omega system is substantially inferior to LORAN-C in accuracy but is devoid of such LORAN-C deficiencies as zonality, the difficulty of use in high latitudes and the difficulty of receiving signals beneath the water. The operating principle of both systems is similar.

The Omega radionavigation system includes eight ground stations located in the United States, Japan, Norway, Australia, Argentina, on Reunion Island, in the Hawaiian Islands and in Liberia. All of them have an umbrella-type antenna of complex design (mast height 350-450 m, antenna length around 3,500 m).

At the present time there are up to 16,000 aircraft (shipboard) receivers of the Omega system.

The **Decca radionavigation system** was developed [razrabotat] in Great Britain at the end of World War II to support aircraft and ship navigation. It is widely used by the navies of Great Britain, France, the FRG, Denmark, Norway and other countries.

Decca is a continuous wave phased hyperbolic navigation system. A system chain consists of four transmitters situated in a triangle, with three of them (slaves) forming its apexes and the fourth (master) located inside. Its operating accuracy depends largely on time of day, which affects radio wave propagation, and on the mutual position of ship and ground stations. The system uses only the ground wave in order to reduce the influence of radio wave propagation conditions.

More than 50 chains of the Decca system presently have been deployed around the globe.

The **NAVSTAR global satellite navigation system** provides highly accurate data to space, airborne, ground and maritime users regardless of time of day or weather conditions. Its operating principle is as a passive rangefinder using highly stable frequency generators.[3]

After it becomes fully operational the system will include 18 satellites (Fig. 1 [figure not reproduced]) arranged in groups of three in six circular orbits around 20,000 km high and with an inclination of 55 degrees. The general alignment of NAVSTAR provides for simultaneous reception at any point of radio signals from at least 3-4 satellites (Fig. 2 [figure not reproduced]).

The system ground complex includes a station for controlling the operation of satellites, a network of control tracking stations, and stations for data transmission to the satellite.

System user equipment (Fig. 3 [figure not reproduced]) consists of a receiver which provides position finding with a given accuracy. Single-channel (Fig. 4 [figure not reproduced]), two-channel and five-channel receivers presently are being developed for NAVSTAR system users.

Simultaneously with long-range navigation systems, military specialists of NATO countries are perfecting and developing precision short-range radionavigation systems which in all likelihood will be in operation before the year 2000.

The Tac-Nav, Mini-Ranger, Trisponder, Argo (all are American); Pulse-8, Hyper-Fix, Highfix-6 (British); Siledis (French) and Artemis (Dutch) presently are being widely used for short-range navigation by navies of the United States, France, Great Britain and other NATO countries. Basic characteristics of these systems are given in Table 2. They permit ships to determine their position in coastal areas with high accuracy. They use various bands of radio waves (LF, MF, HF and VHF) and a complex signal structure.

The **Tac-Nav radionavigation system** provides navigation data to U.S. Marine subunits and supports command and control of assault forces during their landing. The

System	Range, km	Accuracy km	Operating Frequency Band, MHz
United States			
Tac-Nav	4—100	3—5	9310; 9375
Mini-Ranger	75	3—5	5400—5600
Trisponder	75	3—5	9300—9500
Argo	300—700	2—5	1.6—2.0
Great Britain			
Pulse-8	500	10—30	0.1
Hyper-Fix	300—700	2—5	1.6—3.4
Highfix-6	300—700	2—5	1.8
France			
Siledis	200—250	1—5	430—440, 422—445
Netherlands			
Artemis	20	1—3	9000

system's operating principle is that of interrogator-responder. Coordinates of an object are determined by measuring the distance from the interrogator to two responders, the position of which is known.

The **Mini-Ranger radionavigation system** is similar in purpose and operating principle to the Tac-Nav, differing in the radio frequency band used.

The **Trisponder radionavigation system** is similar in operating principle to the Tac-Nav and Mini-Ranger systems and consists of ground and shipboard stations.

The **Argo radionavigation system** is intended basically for short-range navigation of surface combatants. It includes four radio beacons and a shipboard receiver.

The **Pulse-8 system** is similar in operating principle, equipment composition and signal structure to the American LORAN-C long-range radionavigation system. The difference lies in a lesser radiating power and lesser effective range, as well as in the presence of an identical number of pulses in the master and slave station groups. Each station uses a cesium frequency generator with extremely high stability. This permits using the system not only in a hyperbolic navigation mode, but also in a rho-rho navigation mode and increases its effective range. This requires the presence of similar frequency generators in the shipboard receivers, however.

The **Hyper-Fix radionavigation system** was developed in the early 1980's and provides high ship position finding accuracy. It is a hyperbolic navigation system in operating principle. Ships find their position by measuring differences in distances (by the phase-meter method) from the ship to two points (shore ground stations) with known coordinates. The system uses a medium wave radio band; the ground station transmitter operates on two frequencies with time multiplexing. The radionavigation systems includes chains of shore stations and shipboard receiver-display equipment. Each chain has from two to six ground emitting stations, of which one is the master synchronizing the work of the others, the slaves.

The **Highfix-6 radionavigation system** has been in operation since the mid-1970's and is similar in characteristics to the Hyper-Fix radionavigation system.

The **Siledis radionavigation system** was developed in the early 1980's. It permits determining the precise position of ships when laying and sweeping mines and performing hydrographic and other work.

The Siledis includes mobile shore responder beacons (stations) and a shipboard interrogator and receiver-display equipment. A feature of system functioning is that all shore stations operate in a waiting mode and are switched on for emitting only after the master station receives an interrogation signal from aboard ship.

The **Artemis radionavigation system** has high accuracy but short effective range and differs from the other short-range navigation systems by the presence of only one shore station and by the need to use directional antennas both at the shore station and aboard ship.

U.S. and NATO military specialists emphasize that a simultaneous improvement and development of both long-range and short-range navigation systems is the most acceptable way to further increase the effectiveness of navigation support to fleet combat activities.

Footnotes

1. For more detail see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 4, 1980, pp 65-70—Ed.

2. For more detail on the system see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 7, 1985, pp 66-70—Ed.

3. For more detail on the system see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 4, 1981, pp 23-28—Ed.

6904

Shipboard Passive Jamming Systems

18010332n Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 69-70

[Article by Col V. Lavrov]

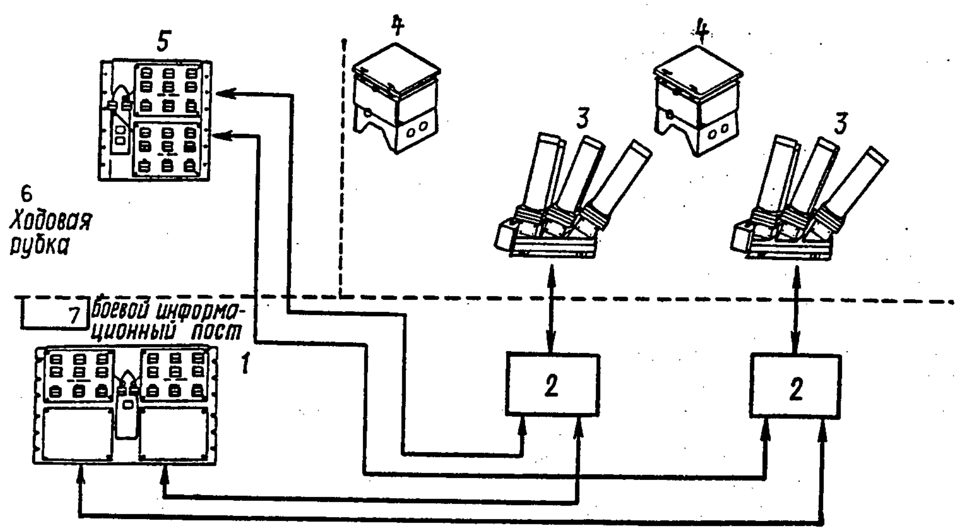
[Text] The most widespread means of protecting surface combatants of the United States Navy and other NATO navies against antiship missiles presently are cartridge-launching passive jamming systems. The experience of the 1973 Arab-Israeli War showed that jamming with free-flight rockets at a range of fire of 10 km or more is inexpedient, and that it is more effective to employ cartridge-launching systems which have a short effective range but fast reaction and insignificant chaff cloud forming time. In the calculations of American specialists, it is best to employ chaff and IR decoys at ranges of 150-400 m and altitudes of 100-150 m, and they can be placed in no more than 20 seconds.

In the mid-1970's the American firm of Tracor developed a passive jamming system—RBOC (Rapid Bloom Offboard Countermeasures)—intended for protecting ships and small combatants against antiship missiles. This system uses several cartridges for rapid forming of an antiradar chaff cloud with a radar cross section exceeding that of the actual target.

At the present time there are several versions of the RBOC system differing in the number of launchers (one, two, four or eight) and number of tubes in them (two, four or six) as well as by the method of control. For example, the version of the RBOC system with manual control (see diagram) includes two six-tube launchers. The Mk 33 variant of the RBOC system is intended for destroyers, the Mk 34 for motor patrol boats and hydrofoils, and Mk 36 for ships of principal types.

The Mk 33 RBOC system includes four Mk 135 six-charge launchers with tubes having different fixed angles of inclination; four Mk 4 cartridge storage lockers, each of which holds 72 IR decoys, chaff, other decoys, smokes and so on; two Mk 164 devices for fire control from the bridge and the Mk 158 master fire control panel; four Mk 160 power supply units; two Mk 173 systems for checking serviceability of IR decoys, as well as connecting cables.

There are two versions of the Mk 135 launchers: Mk 135 Mod 1 with three pairs of tubes (fixed angles of 45, 55 and 65 degrees) and Mk 135 Mod 0 (55, 65 and 75 degrees). The base of each Mk 135 launcher contains a primary coil winding inductively connected with a secondary inductance coil winding of the Mk 171 cartridge, which is filled with chaff (diameter 1 mm) consisting of aluminum-coated glass fibers. They have a varying length (equal to half the wavelength of the homing head



Block diagram of RBOC system with manual control:

Key:
1. Mk 158 master fire control panel
2. Mk 160 power supply unit
3. Mk 135 launcher
4. Cartridge storage locker
5. Mk 164 bridge fire control panel
6. Bridge
7. Combat information center

signal) and cover the 2-20 GHz frequency band corresponding to a wavelength of 150-15 mm. The cartridge is initiated by an electric pulse from a power source, which initially arises in the launcher base primary winding and then is induced in the secondary winding of the cartridge initiating device. The diameter of the Mk 171 Mod 0 cartridge is 112 mm, it is 412 mm high, weighs 4.7 kg, and the chaff volume is 1,886 cm^3. The cartridge's initial velocity and flight time are 70 m/sec and 4 sec respectively. Depending on launcher tube angle of inclination, the cartridge forms a cloud at a height of 105 m and range of 135 m in 4 sec at an angle of inclination of 45 degrees, at a height of 155 m and range of 120 m at 55 degrees, at a height of 130-140 m and range of 90 m at 65 degrees, and at a height of 160 m and range of 70 m at an angle of 75 degrees.

The Mk 158 Mod 0 master fire control panel is located in the ship's combat information center. It is backed up by another two Mk 164 fire control panels located on the bridge. The Mk 160 Mod 0 power supply unit (440 volts, 60 Hz ac is supplied to its input) consists of a transformer, relay, switching element, 24 volt storage battery and battery charger.

In the opinion of American and West European specialists, the merits of the RBOC system include high effectiveness, low cost, small size, light weight, ease of installing on ships of various types, possibility of placing chaff and IR decoys, short reaction time, simplicity of operation, reliable operation, mechanical strength and low consumed power.

In the late 1970's the United States, Great Britain, FRG, Denmark and Norway jointly developed a passive jamming system for protecting ships against air-to-surface and surface-to-surface antiship missiles that is standard within NATO. It is a modification of the RBOC system and is designated the Sea Gnat. It uses the cartridge-launcher method of dispersing chaff and IR decoys for displacing the guidance point of an enemy antiship missile equipped with radar and IR homing heads from the real target. Chaff packets—strips of aluminum foil contained in cartridges—cover a broad band of frequencies.

6904

U.S. Naval Reserve Carriers

18010332o Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) p 72

[Article by Capt 1st Rank Yu. Petrov]

[Text] In addition to 15 aircraft carriers (including five nuclear-powered carriers) in the naval order of battle, the United States has four ships in reserve—two "Hancock"-Class attack carriers, the CVA 31 "Bon Homme Richard" and CV 34 "Oriskany" (see figure [figure not reproduced]), and two "Essex"-Class, the CVS 12 "Hornet" and CVS 20 "Bennington." In addition, the "Hancock"-Class carrier AVT 16 "Lexington" is in commission and being used as a training ship. All were built in the period 1943-1950 and were "Essex"-Class ships. In the course of modernizations (1950's and 1960's) two carriers were refitted as attack carriers and officially categorized as "Hancock"-Class, and the other two were refitted as antisubmarine carriers with retention of their previous class. These ships are essentially similar in architecture and design; individual design differences are connected with modernization work to improve combat capabilities by creating conditions for basing more modern aircraft including antisubmarine aircraft and helicopters (aboard antisubmarine carriers).

The ships' full displacement is 40,600-42,100 tons. The principal dimensions are a length of 274 m, beam 30.7-32.5 m, draft 9.5 m, flight deck length 271 m, flight deck width 52.4-59.5 m, full speed 33 knots, range 12,000 nm at 15 knots, crew of 3,200 (including 1,185 air wing personnel) aboard attack carriers and 2,400 (800) aboard antisubmarine carriers. There can be 70-80 aircraft based on attack carriers and 45 (counting 16-18 helicopters) aboard antisubmarine carriers.

The ships' hulls have 50-76 mm of armor covering the side near the waterline, 38 and 76 mm on flight and hangar decks respectively, and 38 mm on the upper platform deck. During the modernization period all carriers were fitted with enclosed bows for improved seaworthiness. Deck-edge aircraft elevators, the lift capacity of which now reaches 36.5 tons, were used on them for the first time in the U.S. Navy. Three aircraft elevators are installed on each ship: one deck elevator forward between the catapults and two deck-edge elevators (the size of each is 19.2x15.9 m); one starboard aft of the superstructure and one port in the forward part of the angled deck. An angled deck was fitted for the first time abroad aboard one of the ships; there is now a similar deck on all carriers in commission.

The ships are fitted with catapults and arresting gear for supporting the take-off and landing of aircraft. "Hancock"-Class carriers are equipped with two forward C-11 steam catapults with an energy of around 4.8×10^6 kg(f)-m, and the "Essex"-Class is equipped with two forward H-8 hydraulic catapults with an energy of 2.8×10^6 kg(f)-m. A four-barrier hydraulic arresting system is installed aboard the ships for aircraft landings. Its energy intensiveness aboard "Hancock"-Class carriers reaches 4.2×10^6 kg(f)-m (Mk 7 Mod 1 system).

In the opinion of western military specialists, the ships' armament does not meet modern requirements. It is represented by 2-4 single-barrel 127-mm Mk 24 deck turret gun mountings on sponsons. Gun armament was removed from the training carrier.

Radar equipment includes the AN/SPS-30 and -43 air search radars (peak power 1.2-1.5 MW, acquisition range over 400 km), AN/SPS-10 surface search radar and TACAN radionavigation system.

All carriers are equipped with steam power plants consisting of four Westinghouse geared-turbine units with a cumulative output of 150,000 hp operating four propellers. Steam for the turbines is generated at a pressure of 41.7 kg/cm^3 by eight steam boilers.

6904

Communication Routes and Transport of Arabian Peninsula Countries

18010332p Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 83-90

[Article by Col A. Gornostalev]

[Text] Thanks to an important strategic position, Arabian Peninsula countries have been generating heightened attention from militant American circles for a long time now. They view this area as a probable theater of military operations situated in immediate proximity to the Soviet Union's southern borders and, moreover, as an area with enormous petroleum resources.

In early 1983 the U.S. military-political leadership established the unified Central Command (CENTCOM) to support the attainment of its strategic objectives in the Near East. Nineteen states of the Near and Middle East and of North and Northeast Africa, also including Arabian Peninsula countries—Saudi Arabia, Kuwait, Bahrein, Qatar, United Arab Emirates, Oman, Yemen Arab Republic, People's Democratic Republic of Yemen—were included in its "zone of responsibility."

In case combat actions are unleashed in the CENTCOM "zone of responsibility," the Pentagon figures on using military bases and installations located in Saudi Arabia, Kuwait, Bahrein, the United Arab Emirates and Oman for receiving troops and military cargoes moved from the United States. Advance measures to improve the infrastructure of Gulf states are being carried out for this purpose with the participation of American military specialists. Air and naval bases, airfields, ports, POL depots, ammunition depots and other supply depots are being modernized or built, military compounds are being built and communication routes are being developed here.

The United States is making extensive use of military and other facilities of these states in the interests of its Armed Forces under the pretext of ensuring the security of the region's regimes and countries and of oil fields located there. In addition, vigorous efforts are being made to conclude agreements with them for permanent use of air space and territory in the interests of the Rapid Deployment Force, with serious attention being given to the development of communication routes and transport in the region.

As the foreign press notes, in recent years there has been a substantial improvement in the transport infrastructure on the Arabian Peninsula, but it still does not fully meet the modern demands being placed on it: many roads do not have sufficient capacity and are not fully coping with increased freight flows, the inventory of transport equipment requires renewal and so on.

Steps are being taken to modernize motor, marine, air, pipeline[1] and to a lesser extent rail transport for the purpose of further development [razvitiye] of the transport system in Arabian Peninsula countries (Fig. 1). New cargo processing technology is being introduced in ports and major transportation centers, container shipments are being organized, and Ro-Ro vessels and large-tonnage bulk carriers are being used.

Motor transport. Judging from western press reports, there has been a sharp increase in the volume of motor freight and passenger movements in the region's states in recent years. They are supplementing traditional maritime shipping from countries of Western Europe more and more, and this especially concerns the delivery of costly and perishable freight. According to the data of foreign references, the overall length of international highways and local roads is over 120,000 km, including around 45,000 km with hard surface (Table 1).

All highways running through territories of Near Eastern countries are divided into four classes depending on design features. Class 0 highways have four or more lanes of traffic as well as dividing strips, and they can have two independent roadbeds for traffic in each direction and an asphalt concrete road surface; class I highways have two or more traffic lanes at least 3.5 m wide, one roadbed, and asphalt concrete surface; class II highways have two traffic lanes at least 3 m wide, and asphalt concrete or double bituminous surface; class III highways have two traffic lanes less than 3 m wide and double bituminous surface. Road capacity depends on the class and equals 12,000, 4,000, 2,000 and 1,000 vehicles per day in one direction respectively. Two main international routes—M1 and M2—have been built on the Arabian Peninsula.

Western highway M1 Europe-Near East is one of the most important. It runs from the borders of Saudi Arabia through Tebuk-Medina-Jidda-Abha-Sana (Yemen Arab Republic)-Taizz and ends in Aden (People's Democratic Republic of Yemen). The length of the route within these limits is almost 2,850 km and width of shoulders is around 2 m. Maximum grades in some sections of the highway in the Yemen Arab Republic reach 15 percent and the curve radius is 25-310 m. Traffic speed of passenger vehicles must not exceed 80 km/hr, and trucks

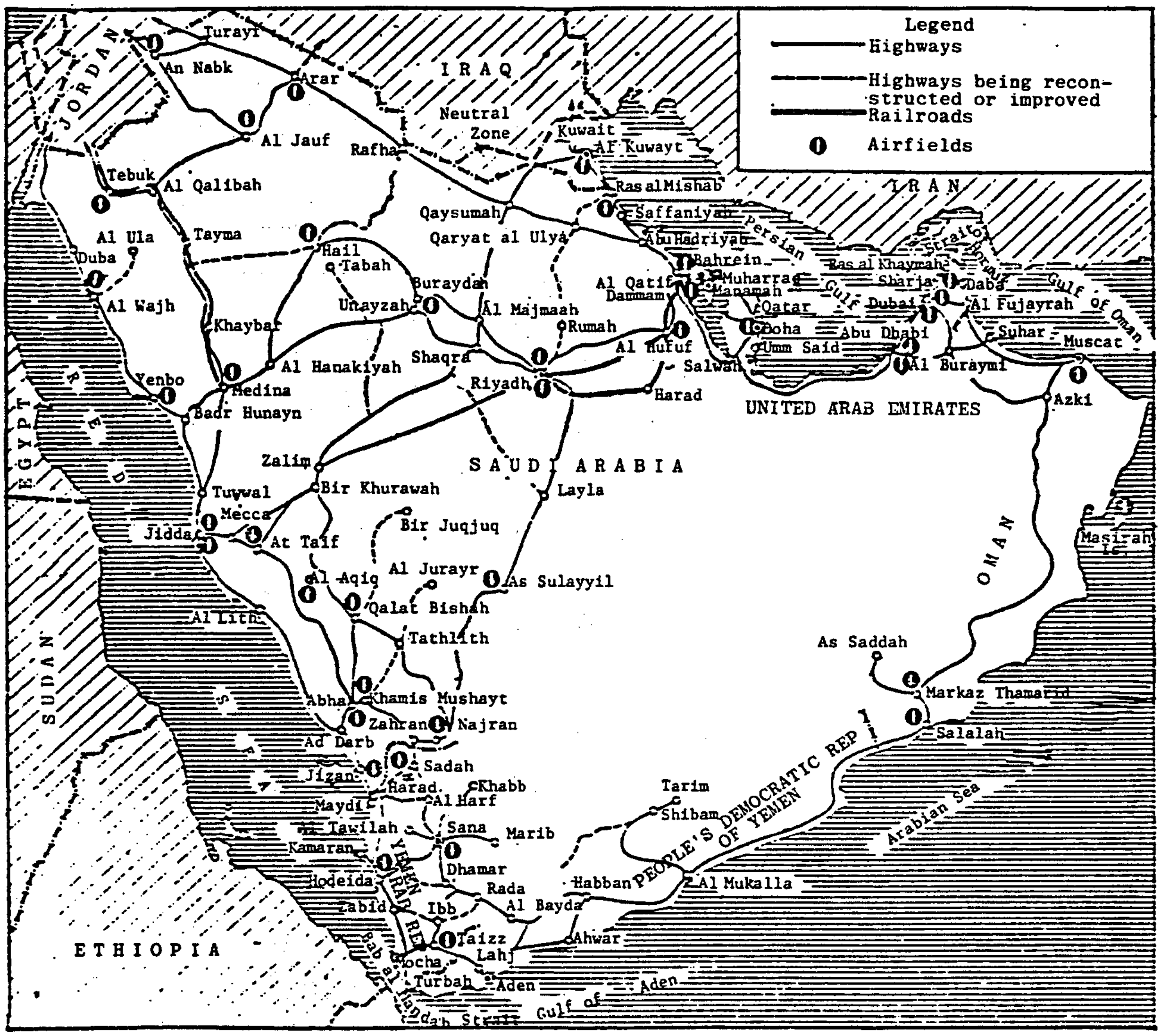


Fig. 1. Diagram of principal transportation routes of Arabian Peninsula countries

60 km/hr. There are two traffic lanes with asphalt surface on practically the entire length of the road and its capacity is up to 6,000 vehicles per day in one direction.

Eastern highway M2 Europe-Near East is a continuation of European route E 90. Within the limits of the Arabian Peninsula it runs through Al Kuwait-Mina Saud-Dammam-Salwa-Abu Dhabi and ends in Muscat, capital of Oman. Overall length is around 2,000 km. The majority of its sections have two roadways each up to 11 m wide with dividing strips of 10 m and shoulders of up to 2 m. Maximum grades are no more than 6 percent, curve radii are from 120 to 2,000 m, and permissible passenger vehicle speed is 100 km/hr, trucks 80 km/hr. The capacity is somewhat higher than highway M1: 10,000 vehicles per day.

Regional and local roads in Arabian Peninsula countries usually have one roadway up to 8 m wide, a maximum grade of around 4 percent (up to 15 percent only in the southern part of the peninsula), curve radius is 35-2,000 m, and permissible speed for passenger vehicles is 100 km/hr and for trucks 80 km/hr.

In Saudi Arabia motor transport plays the leading role both in freight and passenger movements. Private companies chiefly handle freight transport. Passenger movements have been handled since 1979 by a state company, the services of which are used annually by around 118 million persons.

Highway construction in other countries of the region has seen somewhat less development, but at the present time the majority of cities and major settlements are

Route	Length, km	Road Class / Roadway Width m	Maximum Gradient %	Curve Radius, m	Speed Limit, km/hr	Capacity, Vehicles per Day (One Way)
Western Highway M1 (Europe-Near East)	2846	0—3 / 6—15,2	15	25—310	80	6000
Eastern Highway M2 (Europe-Near East)	1994	0—1 / 7—22	6	120—2000	100	10 000
An Nabk-Abu Hadriyah	1078	1 / 7—7,6	2	850	80	6500
Medina-Riyadh	1011	1 / 7,6	4	850	80	6500
Zalim-Riyadh	650	1 / 7—8	4	520	80	6500
At Taif-Riyadh-Al Hufuf	1229	0—1 / 7,6	4	850—1650	80	9000
Zahran-Riyadh	1051	1—2 / 7,2—7,6	5	310—850	80	6500
Aden-Muscat	2350	0—3 / 6,7—7,5	15	50—520	70	2000

interconnected by hard-surface roads. Construction of the largest highway complex in the Near East between Al Khubar (Saudi Arabia) and Diraz (Bahrein) with an overall length of almost 25 km was completed in 1986. It includes five successively built-up dams interconnected by bridges beneath which space has been provided for vessel passage. This route provides a capacity of around 3,000 motor transport means per hour.

The region's countries also are giving much attention to development [razvitiye] of intraurban highways and construction of new ring roads around important administrative-industrial centers. In Saudi Arabia the latter include Riyadh, Dammam, Mecca, Medina, Jidda, Abha, Jizan, At Taif and Tebuk. In other countries ring roads are built mainly around capitals.

According to foreign press reports, the motor vehicle fleet in the region's countries is growing at high rates and numbers around 2.5 million means of transport of various types (Table 2).

Maritime transport. Washed by waters of the Red and Arabian seas, the gulfs of Aden and Oman, and the Persian Gulf, the Arabian Peninsula is in a zone of intensive world shipping lanes linking three continents. A considerable portion of freight shipments of the region's countries also is accomplished by maritime transport, which plays an especially important role in the export of the oil and gas produced here to many world states. Their sale abroad serves as the primary source of foreign currency needed to finance the most important sectors of industry, agriculture and transportation, including development [razvitiye] of the principal seaports. But the unending Iran-Iraq war has a considerable negative effect on international shipping in the Persian Gulf. Over the last six years around 450 transport vessels have been fired on, received damage, or sank in the Persian Gulf, with 1987 accounting for the greatest number.

The capacities of many ports have not been fully used in recent years in connection with the decreased volume of oil export. The import volume of many commodities remains rather stable, with a considerable portion consisting of industrial equipment, transport equipment, construction materials, food products and so on.

Wide adoption of container shipments of general[2] and other cargoes affected the development [razvitiye] of ports in the region. In particular, appropriations for their reconstruction were increased considerably, new entities were created for managing production activities, foreign specialists were brought in on a long-term basis, and new container terminals and specially equipped berths for servicing Ro-Ro vessels, cement carriers and vessels carrying building constructions and cattle have been built.

Country	Length of Highways, km		Motor Vehicle Fleet, thousands
	Total	Including With Hard Surface	
Saudi Arabia	72 000	30 000	Over 1400
Kuwait	16 000	2300	640
Bahrein	700	Over 200	96
Qatar	•	2200	84.1
United Arab Emirates	•	2500	500
Oman	24 500	6800	71.2
Yemen Arab Republic	Over 7000	2800	Over 80
People's Democratic Republic of Yemen	9000	2300	28.9

More and more attention is being given to adjusting inter-Arab cooperation with the objective of strengthening the economic situation and weakening competition on the part of large foreign companies. There has been a noticeable increase in the role of the Cooperation Council for the Arab States of the Gulf, established in 1981. It includes Saudi Arabia, Kuwait, the United Arab Emirates, Bahrein, Qatar and Oman.

According to foreign press data, the tonnage of commercial fleets in Arabian Peninsula states increased. The overall number of marine vessels (counting fishing vessels) with a capacity of 100 register tons or more exceeds 1,000. Their cumulative deadweight is 11 million tons. Over 40 seaports[3] (Figs. 2 and 3 [figures not reproduced]) operate to transfer cargoes from land to water and back to the peninsula. When ports are modernized their use is envisaged both by national naval forces and by ships of navies of the United States and other NATO countries.

Foreign trade shipping in the region is handled by two international shipping companies—United Shipping and Arab Maritime Petroleum Transport—with headquarters in Kuwait. The former was established in 1976 with the influx of capital and vessels of six Arab countries—Kuwait, Saudi Arabia, Qatar, Iraq, Bahrein and the United Arab Emirates. Its fleet numbers around 60 dry cargo vessels with an overall gross tonnage of more than one million register tons. The fleet has been appreciably replaced of late. Approximately 25 percent of the vessels are intended for transporting freight in containers and nine (built in South Korea during 1982-1983) have a capacity of 1,846 containers each. Replacement of vessels permitted the company to expand its activities in servicing shipments to countries of Europe, the Mediterranean, the Far East and America. In 1983 the company began container shipments between eastern ports of the United States and India.

Arab Maritime Petroleum Transport was established in 1973 by the Organization of Arab Petroleum Exporting Countries (OAPEC) with the participation of capital and vessels of the tanker fleets of nine states (including Kuwait, Saudi Arabia, Qatar, Bahrein and the United Arab Emirates). But from the very beginning its activities encountered significant difficulties connected with the fact that the intention of using primarily supertankers came into contradiction with the situation on the world oil market, which has grown more complicated in recent years. As a result eight tankers with an overall register tonnage of 1.4 million tons were inactive for a lengthy time, which required great additional expenditures for their upkeep and servicing.

Saudi Arabia also has one state shipping company and more than 50 private companies. They provide freight shipments to countries of the Gulf, Middle and Far East, Europe and the United States. Many of them specialize in transporting specific kinds of commodities.

Kuwait's largest shipping companies include the state tanker company engaged in transporting oil to Western Europe and the Far East, and a state company specializing in delivering general freight and containers to East Africa.

The largest of the seven shipping companies of the United Arab Emirates is the state tanker company of the Emirate of Abu Dhabi. Two state shipping companies and one private shipping company, which have vessels for general freight and containers, function in Qatar. Foreign trade shipments in Oman, the Yemen Arab Republic and Bahrein are accomplished basically by foreign vessels. Data on distribution of the fleet in the region's countries are given in Table 3.

Rail transport on the Arabian Peninsula exists only in Saudi Arabia. It is state-owned and occupies an insignificant place in the overall volume of freight shipments, which somewhat exceed seven million tons per year. Each year some 300,000 passengers are carried. The length of railroads is 875 km. Presently only two rail lines are in operation in the country: Dammam-Al Hufuf-Haradh-Riyadh and Al Hufuf-Riyadh.

Vessel Classes	Saudi Arabia		Kuwait		United Arab Emirates	
	Number of Vessels	Deadweight, thous tons	Number of Vessels	Deadweight, thous tons	Number of Vessels	Deadweight, thous tons
Total Vessels, including:	380	4956	239	4121	220	1019
Tankers	90	1588	26	1593	32	373
General Cargo Ships	75	444	38	329	64	151
Containerships	5	83.7	7	185.6	3	79.5
Dry Cargo Ships	94	914.7	45	514	68	238.6

Vessel Classes	Qatar		Bahrein		Oman	
	Number of Vessels	Deadweight, thous tons	Number of Vessels	Deadweight, thous tons	Number of Vessels	Dead weight, thous tons
Total Vessels, including:	55	458	98	64	29	13
Tankers	5	112	5	3.3	2	0.4
General Cargo Ships	11	95	9	8	4	3.7
Containerships	3	88.2	—	—	—	—
Dry Cargo Ships	14	183.4	10	24.4	4	3.7

Vessel Classes	Total	
	Number of Vessels	Deadweight, thous tons
Total Vessels, including:	1021	10631
Tankers	160	3668.7
General Cargo Ships	201	1030.7
Containerships	18	437
Dry Cargo Ships	235	1873.8

The first line was built during 1946-1952 in place of an old road created in 1887. It has one track 1,435 mm wide. Rails are laid on wooden ties, the maximum permissible axle load is 29 tons, and minimum curve radius on the line is around 580 m. Train speed is up to 100 km/hr. The mainline is intended chiefly for transporting oil from Haradh and Abqaiq to the port of Dammam, and for transporting imported freight in the reverse direction.

A dispatch control center and central repair shops are located in the city of Dammam. All railroad stations on the line have telephone communications. Train traffic control is exercised basically by radio in the HF band. One of the best equipped stations is Dammam, which has more than 40 station tracks.

Rails on the Al Hufuf-Riyadh line stretching 440 km are laid on reinforced concrete ties, the minimum curve radius is 100 m, and bed grades are up to 1 percent. A speed of 150 km/hr is permitted in some sections of the road.

In addition, the Hejaz Railroad runs through the territory of Saudi Arabia. It begins in the city of Damascus (Syria) and runs through the city of Maan (Jordan) to the city of Medina, with a total length of 1,199 km (gauge of 1,050 mm), including 680 km through Saudi territory. This route was built in 1908 but is not in operation at the present time. Western specialists propose to restore and modernize the Hejaz Railroad. They estimate the work will take over ten years. After reconstruction, the railroad would permit exporting petroleum to countries of the Near East, through Turkey to West European countries, and through the Jordanian port of Aqaba to the Mediterranean area. Passenger movements of over 15,000 persons a day also could be made.

Some 170 km of spur tracks have been built in the country connecting industrial and large military installations. The main sections have been prepared in the areas of Dammam, al-Kharj and Riyadh. Rolling stock in 1986 consisted of around 60 diesel locomotives, over 2,300 freight cars and almost 60 passenger cars.

In accordance with the country's economic development programs Saudi specialists plan to perform engineering feasibility studies for construction of new lines: Riyadh-Jidda, Medina-Mecca, Riyadh-Buraydah-Medina-Yenbo.

Persian Gulf countries also are proposing joint construction of a transnational railroad with a total length of 1,700 km which would connect Iraq, Kuwait, Saudi Arabia and the United Arab Emirates.

Air transport of Arabian Peninsula states plays an important role in domestic and international passenger movements and in delivering urgent freight. Each year civil aviation services are used by around five million persons and the volume of freight shipments exceeds 500 million ton-km.

Air transport has seen the most significant development in Saudi Arabia, where there are more than 40 international and domestic airlines and 40 airports, including approximately 30 with runways 2,400 m or more long. Communication between the largest cities within the country and abroad is provided basically by the national airline company Saudi Arabian Airlines. The civil aviation aircraft fleet in Saudi Arabia consists of more than 50 aircraft of different modifications. The most important international airports function in the cities of Riyadh (it can handle to 7.5 million passengers a year) and Jidda (over 6 million passengers).

Air movements in Kuwait are accomplished by national and foreign companies. The civil air fleet includes around 20 aircraft, with delivery of another ten aircraft from abroad planned. Six airports have been built in the country, the largest located in the city of Al Kuwait and capable of serving up to 4 million passengers a year and receiving around 40 aircraft each hour.

The Gulf Air joint airline company of Bahrein, Qatar, Oman and the United Arab Emirates services air routes between neighboring Arab states and accomplishes long-distance international movements. The company has approximately 50 aircraft and an order has been placed to acquire about another 20. The territories of these countries have almost 50 airports, including nine with runways 2,400 m or more long. It is believed that by the year 2000 the new Abu Dhabi airport in the United Arab Emirates will be able to receive six million passengers a year. Large international airports are located in the city of Doha (Qatar) and on the Island of Muharraq (Bahrein).

The Yemen Arab Republic has more than ten airports served by a national airline company and foreign airline companies. The aircraft fleet consists of around ten aircraft.

Capitals of the region's countries Riyadh, Al Kuwait, Manama, Doha, Abu Dhabi, Muscat and Sana are major air route centers (Table 4). In addition, important airports have been built in the cities of Dammam, Dhahran, Jidda (all in Saudi Arabia), Dubai, Ras al Khaymah, Sharjah (United Arab Emirates) and Salalah (Oman).

Foreign specialists believe that measures to develop [razvitiye] transportation routes and transport being carried out in Arabian Peninsula countries will significantly contribute to further development [razvitiye] of the entire infrastructure of region states, something in which the United States and other NATO bloc member countries are directly interested today.

Footnotes

1. For more detail on pipeline transport of Arabian Peninsula countries see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 11, 1986, pp 69-74—Ed.

Airfield	Coordinates		Height Above Sea Level, m	Main Runway	
	North Latitude, deg-min	East Longitude, deg-min		Length x Width, m	Runway Heading, degrees
1	2	3	4	5	6
Saudi Arabia					
Abha	18—14	42—39	2085	334x45	130—310
Abqaiq	25—57	49—38	01	1824x45	150—330
Arar	30—54	41—08	554	3042x45	100—280
Qalat Bishah	19—59	42—37	1164	3043x45	180—360
Buraydah	26—18	43—46	648	2092x45	150—330
Dharhan	26—15	50—09	25	3050x45	160—340
Jizan	16—54	42—35	6	3042x45	150—330
Jidda	21—41	39—09	5	3790x60	160—340
Medina	24—33	39—43	653	3840x45	170—350
Najran	17—37	44—26	1210	3042x45	60—240
Ras al Mishab	28—05	48—37	3	2434x30	160—340
Tebuk	28—22	36—37	776	3341x45	60—240
Hail	27—26	41—41	1013	3705x45	180—360
Khamis Mushayt	18—18	42—48	2061	3700x45	60—240
Hafar al Batin	28—20	46—07	357	3043x45	160—340
Al Aqiq	20—18	41—38	1008	3341x45	70—250
Al Wajh	26—13	36—29	20	3043x45	150—330
Al Jauf	29—47	40—06	687	3650x45	100—280
Al Jubayl	27—02	49—24	8	3989x45	170—350
Al Hufuf	25—17	49—29	179	3052x45	160—340
An Nabk	31—24	37—16	508	3042x45	100—280
Riyadh	24—58	46—43	623	4180x60	150—330
Riyadh	24—43	46—44	633	4039x45	10—190
As Sulayyil	20—28	45—36	614	3003x45	100—180
At Taif	21—29	40—33	1474	3725x45	70—250
Yenbo	24—09	38—04	8	3201x45	100—280
Kuwait					
Al Kuwayt	29—13	47—58	64	3491x45	150—330
Bahrein					
Muharraq	26—16	50—38	2	3953x60	120—300
Qatar					
Doha	25—16	51—34	10	4500x46	160—340
Oman					
Gaba	21—23	57—03	135	1946x46	40—220
Muscat	23—36	58—17	14	3576x45	80—260
Markaz Thamarid	17—40	54—01	448	5830x50	170—350
Salalah	17—03	54—06	22	2720x45	70—250
United Arab Emirates					
Abu Dhabi	24—26	54—39	27	4089x45	130—310
Abu Dhabi	24—26	54—27	2	3192x46	130—310
Jabal az Zannah	24—11	53—37	13	2195x46	130—310
Dubai	25—15	55—21	10	3989x46	120—300
Ras al Khaymah	25—37	55—56	31	3750x45	160—340
Sharja	35—20	55—31	33	3750x45	120—300
Yemen Arab Republic					
Sadah	16—58	43—44	1860	2053x35	180—360
Sana	15—29	44—13	2200	3243x46	180—360
Taizz	13—41	44—08	1398	2992x45	10—190
Hodeida	14—45	43—50	12	2992x45	30—210

1. Main runway at all airfields has asphalt surface except for Jidda airfield (concrete).

2. "General cargoes" is a collective term for tare and piece cargoes carried in combined lots—Ed.3. Concerning seaports of Arabian Peninsula countries see ZARUBEZHNOYE VOYENNOYE OBOZRENIYE, No 5, 1984, pp 68-74.

6904

Reorganization of FRG Air Force Air Defense

18010332q Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) p 91

[Article by Col V. Viktorov]

[Text] With the beginning of delivery of the Patriot and Roland surface-to-air missile systems to the troops, a reorganization of West German Air Force air defense units and subunits will begin under plans for developing the FRG air defense system. In particular, the six Improved Hawk and Nike-Hercules SAM regiments in the Air Force order of battle are to be disbanded (the latter are to be removed from the inventory and replaced by the Patriot SAM system). It is planned to form six brigade-level air defense commands in their place, each of which will include Patriot, Improved Hawk and Roland SAM units and subunits. Wings, groups and squadrons will be organized in place of regiments and battalions.

The foreign press reports that the aforementioned six air defense commands will include six Patriot SAM wings (with 36 squadrons, a total of 288 launchers), nine Improved Hawk SAM wings (36 squadrons, 216 launchers), and three Roland SAM groups (15 squadrons, 95 launchers, and one auxiliary subunit). The Patriot and Improved Hawk SAM squadrons will have one SAM system each.

The West German version of the Patriot SAM system differs from the American in that its basic equipment is installed not on semitrailers, but on trucks with improved crosscountry capability: one with radar, eight with launcher (four ready-to-launch missiles on each), one with command post, one with power unit (two 150 kw diesel generators), one with radio communications equipment, one staff truck, three with gear for checking status and maintenance, and four with a second unit of fire of missiles. In addition it will include a number of components being created [sozdavat] by West German firms such as the IFF 1990 recognition system, a new diesel generator, a 30 m telescopic radio mast and so on.

NATO military experts believe that after refitting and reorganization of West German Air Force SAM units and completion of the program for modernizing FRG air defense control entities the tactical capabilities of its air defense system, and of the NATO allied air defense system in the Central Europe Theater (of which it is the basis) on the whole, will increase considerably and will meet modern requirements.

6904

Great Britain Increases Civil Defense Expenditures

18010332r Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 93-94

[Article by Col V. Goncharov]

[Text] The Conservative government is taking new steps to improve the effectiveness of national civil defense. This is clearly indicated by practical measures in this area as well as by the growth in appropriations for them. For example, while civil defense expenditures for fiscal year 1980/81 were 34.2 million pounds sterling, this figure reached 97.9 million in fiscal year 1986/87.

The foreign press notes that the government of Great Britain lately has begun to pay greater attention to civil defense. An amendment to the 1948 civil defense law was adopted in August 1986 and a number of changes were made to the 1983 statute on local civil defense entities. These acts specify that civil defense is called upon to ensure accomplishment of missions both in peacetime and wartime. It is pointed out that its forces and resources must take a most active part in mopping up the aftermath of natural disasters, accidents and catastrophes. This must become a component part of preparation of the civil defense system for operation in case of a nuclear missile war.

In the country a three-year program of civil defense development for 1988-1990 has been worked out, which provides above all for activation of work to expand the hardened command post system for all levels of leadership and to construct multipurpose means of collective protection. Twenty-one million pounds sterling were allocated for development of the hardened command post network; this money is intended for building 53 new posts by 1989. In the assessment of the UK civil defense administration, the country needs to have 513 hardened command posts. At the present time almost 230 such posts already are functioning. The development program envisages making approximately 20 hardened command posts operational per year so as to fulfill the outlined plans by 1999.

The role of local organs of authority in the civil defense area is increasing. Financial assistance on the part of the state has increased to counties and cities from 3.4 million pounds sterling in fiscal year 1979/80 to 14 million in fiscal year 1986/87. In accordance with the

adopted program, main efforts of local CD organs are to be directed at developing [razrabotka] and improving existing plans, constructing and completing hardened command posts, preparing and training the populace, and conducting CD exercises. It is also planned to have a more active participation of county CD entities in exercises of the observation and warning service. The country's Ministry of the Home Office (civil defense is under its purview) plans to hold one exercise a year in each civil defense district (there are ten total) and one every two years involving all civil defense district staffs.

Considerable attention will be given in the near future to modernizing the system warning the population about a possible enemy attack, although according to a statement of the country's civil defense heads, even now it is in an enormously greater state of readiness than similar systems in other NATO member states.

6904

Articles Not Translated from ZARUBEZHNOYE VOYENNOYE OBOZRENIYE No 2, February 1988

18010332s Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88) pp 1-2

6904

Publication Data

18010332t Moscow ZARUBEZHNOYE VOYENNOYE OBOZRENIYE in Russian No 2, Feb 88 (signed to press 5 Feb 88)

[Text] English title: FOREIGN MILITARY REVIEW

Russian title: ZARUBEZHNOYE VOYENNOYE OBOZRENIYE

Editor: O. N. Abramov

Publishing house: Izdatelstvo "Krasnaya zvezda"

Place of publication: Moscow

Date of publication: February 1988

Signed to press: 5 February 1988

6904